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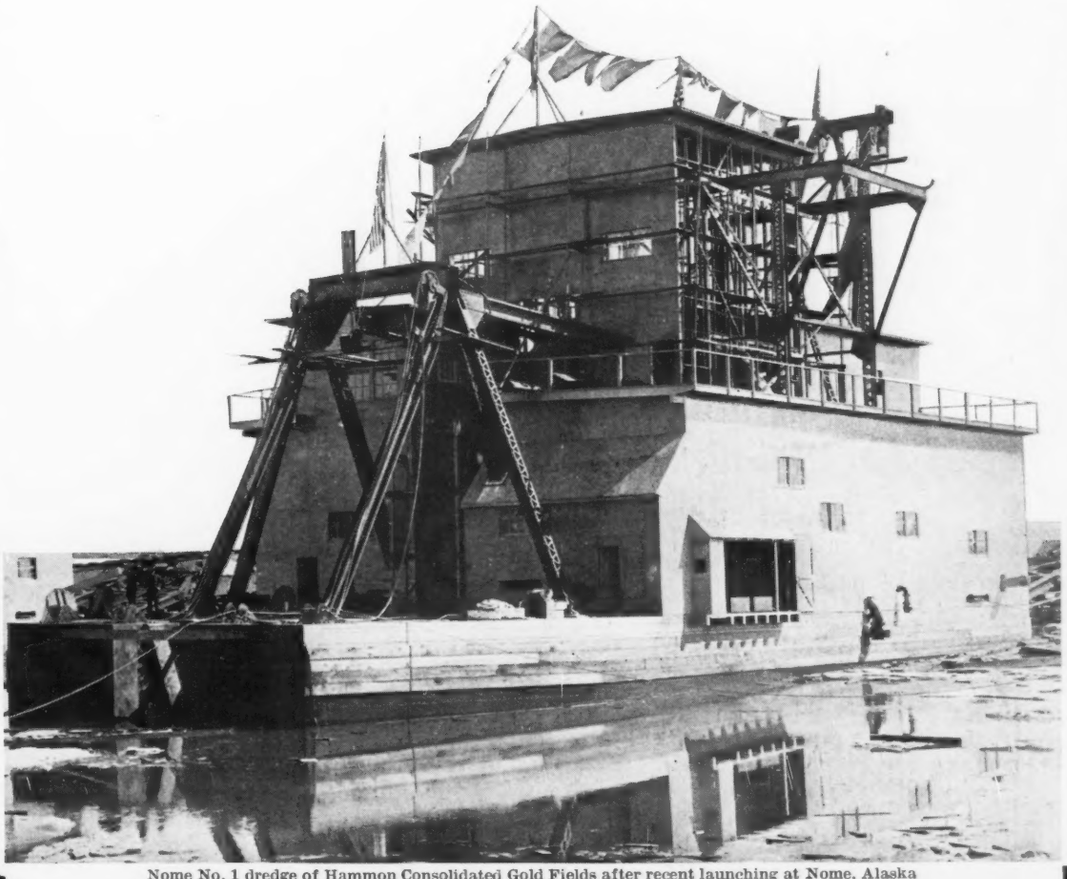

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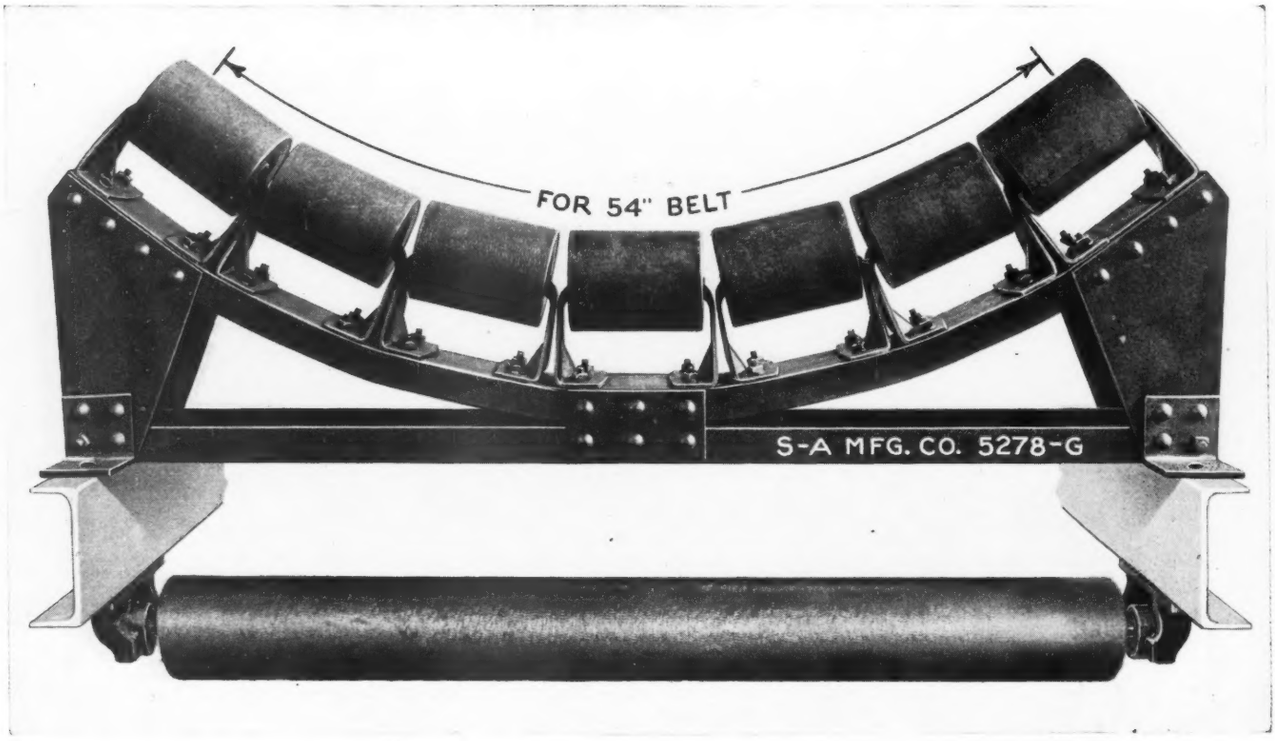

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ENGINEERING & MINING
JOURNAL-PRESS
JOSIAH EDWARD SPURR, Editor

Volume 116 New York, August 25, 1923 *Number* 8

Development of Concessions

ACCORDING TO NEWSPAPER REPORTS, a syndicate of bankers, engineers, and capitalists, headed by the Chicago traction magnate, Samuel Insull, has undertaken to develop the natural resources in the Republic of Colombia. These resources will include "minerals, precious stones, and water-power rights," will involve a colonization scheme, and the building of a railroad from Bogota to the Atlantic Coast.

Whatever truth there may be in the rumor, it excites the reflection that development of mineral resources in many of the unsettled parts of the world must await some such comprehensive and monopolistic plan. In the usual and time-honored procedure of development, the settler has held back for the railroad, and the railroad for the settler, the miner has explored ahead of both, only to bring back more or less uncertain promises of what he could do if the country were settled and he had transportation facilities—promises rightly considered as not sufficiently definite to warrant railroad building. When some rich find of ore was made, with a mad rush came settlers, railroads, and the wasteful parasites of the human race. When the Nevada boom was on, three competitive railroads were rushed from three different directions to Goldfield. One road would have been ample. Two of them were soon abandoned after operating for a short time.

But the climes and natural conditions which can duplicate the old-style mining boom and rush are about exhausted. In spite of the fables of the hardihood of the prospector, emeralds in Colombia or gold in Costa Rica does not unleash a rush of the hardy, all-conquering type. The tropical jungle, the rains, the heat, are effective barriers to adventure. And the same is true of all but the richest ore deposits in the barren and dreary sub-Arctic regions. These less favorable stamping grounds for the hardy but untrained and unbacked, and therefore relatively unfit, remain in many parts of the world, rich in natural resources—promising fields for intelligence, capital, and organization. Many ambitious projects to subjugate and develop profitably these climatically less favorable fields have failed through insufficiency of capital or intelligence. Other projects have succeeded, and all should succeed if properly studied and planned, backed by more than enough capital, and followed up with tireless patience. The Belgian Congo development is an example of such successful exploitation; the Dietrich concession in Nicaragua a minor example of a monopolistic concession which failed through lack of capital, intelligence, and patience.

Our old predilections for competition and giving every man a chance at new mineral developments have worked out well in the temperate zones and in favorable parts of the zones of extreme climates. This system has fought itself to a standstill in many tropical regions and in countries whose political conditions are among the chief factors which go to make up successful mining. For such regions, the plain truth is that success demands huge and monopolistic concessions, covering every phase of industry—an industrial sub-kingdom, in fact—and a close and powerful contact with the political government. Under any other conditions the neglected natural resources will sleep on, awaiting some future period of high organization and unlimited cash and technical skill.

A Prospecting Problem

A FEW WEEKS AGO an elderly western prospector called upon an officer of a large mining company—to whom he was well known—and tried to interest him in prospecting and developing some mining claims located in a productive area a few hundred miles away from the company's headquarters. The prospector admitted that the properties which he recommended for development were hardly more than holes in the ground at present, but contended that they justified the expenditure of time and money to determine definitely whether or not they might be transformed into mines. The official of the mining company was very appreciative of the position of the prospector and realized that a nice problem had presented itself. Was the mining company which he represented, or some kindred organization, warranted in furnishing funds for the development of prospects whose future was highly speculative? Should not the company follow the usual practice and wait until prospects had been presented to it with showings sufficiently attractive to encourage taking an option or making an outright purchase?

The prospector contended warmly that it was up to the large and strong mining companies to stimulate mining whenever it showed signs of declining activity. Furthermore, they should aid in the location of new prospects and the development of old ones.

His argument had some foundation in fact. Few mining companies deliberately map out a prospecting campaign and use part of their financial resources in executing it. They rely almost wholly upon the reports which are brought to them by outsiders or by their own scouts on new or old enterprises which have possibilities of becoming valuable mines. The reason for this condition is simple. The large mining companies are nearly all stock companies and are responsible to their stockholders. It is doubtful if the board of directors would sanction any policy which savored of a risky nature. The stockholders are primarily concerned with the size and regularity of their dividends. The pressure of this attitude on the part of the stockholders is enough to deter the directors from authorizing any program unlikely to have an early favorable effect upon income. Yet no one will deny that the large mining corporations are admirably suited for the work of prospecting. They have—or should have—a competent geological and exploration staff whose skill should enable them to keep up the scientific search for ore.

Moreover, these companies wish to perpetuate their corporate existence—not an easy matter for a mining enterprise, which is all the more reason for encouraging prospecting and the acquisition of likely prospects. If the large mining company happens to be engaged principally in smelting, its prosperity—as it so well knows—is dependent upon the productivity of the territory which it serves. So that it would seem of paramount importance to all these companies to do all in their power to aid prospecting financially as well as mentally.

A moment's reflection shows how haphazard is the modern method of finding a mine. A prospector goes in to the hills in a district which he thinks likely to contain ore. Perhaps he has been grubstaked; then again he may be financing his trip from funds accumulated by dint of hard work during the winter at some mine. His wanderings may disclose something, but more often he becomes discouraged from an exhaustion of his meager resources or may be forced to quit because of the pressure of adverse living or business conditions as at present. On such a system we depend for our new crop of mines.

Oxygenated Air in Metallurgy

SOME MONTHS AGO we mentioned editorially the proposed work of the Bureau of Mines in seeking means for the production of oxygen or oxygen-enriched air at a sufficiently low cost to permit its wider use in metallurgy; and in experimenting to determine in what ways such enriched air might be most profitably used. The work is entirely distinct from the investigation of liquid oxygen explosives, although it is entirely possible that in developing a cheap source of oxygen some apparatus may be perfected that would also be adaptable to the manufacture of liquid oxygen for explosives.

The first report of the Committee for the Application of Oxygen or Oxygenated Air has just been issued as Serial No. 2,502, *Reports of Investigations*, by the Bureau of Mines, and we have had the privilege of seeing an advance copy. The report, though a somewhat long one of forty-eight pages, is in the nature of a prospectus rather than a record of work actually done, but it is illuminating as indicating the great possibilities of oxygen-enriched air in ferrous metallurgy. In the first place, it is interesting to note that 99 per cent oxygen in the gaseous form can probably be produced on a large scale at a cost of $3 per 2,240 lb. This is much cheaper, of course, than it can be obtained for in the ordinary cylinders, in small quantities, and a lower figure than has been assumed as possible in most calculations that have been made by various metallurgists.

F. W. Davis, the author of the paper, first discusses the use of oxygenated air in the blast-furnace smelting of iron ore. The indications are that production costs will be decreased by increasing the temperature that will be obtained per unit of fuel; by making no excess of coke over the theoretical amount necessary; and by removing the necessity for hot blast. Also, furnace output will be increased, the process will be more flexible, the product will be more uniform, the inaccessible hearth and bosh section of a furnace will no longer be the limiting factor, lower grade ores and higher ash cokes can be used, and the sulphur in the pig iron produced will be lower than with the present practice. "Doubtless," says Mr. Davis, "the application of oxygen will revolutionize the art of smelting and it will probably change the whole operation and equipment." These are strong words, but in the light of the investigation they seem warranted.

The use of oxygen in the bessemer process is also discussed, the conclusion being reached that the field of the basic bessemer process would be much extended thereby. In the open-hearth process, temperatures can hardly be increased much above the present range owing to the limit set by the refractories now available, but it is suggested that these might be improved. Also a cheaper fuel can be used; oxygen can be used instead of iron ore for oxidizing, thus making a higher grade product and decreasing the time required for a heat by three hours; and, possibly most important of all, steel of electric-furnace quality, commanding a high price, can be made in the open hearth because a highly reducing atmosphere and slag can be maintained.

Oxygen is also shown to be useful in the manufacture of artificial gas; the cost will be somewhat greater, but the heating power of the gas, owing to the decreased content of nitrogen, can be nearly doubled. The last of the five topics discussed by Mr. Davis is that of the application of oxygen in the manufacture of ferro-alloys, specifically ferromanganese, the indications being that the processes can be much more efficiently conducted than is now being done.

The Bureau has evidently hit upon a field of great promise, and its investigations have just as much promise in non-ferrous fields, as in the metallurgy of copper, zinc, and lead, as they have in the precincts covered in this report. The cheap production of oxygen and its wide employment may well become the outstanding achievement of the next decade in the realm of mining and metallurgy. The experimental work should be carried on as rapidly and thoroughly as possible, and it is to be hoped that the necessary appropriations will be forthcoming to permit this.

Mr. Davis says, "The findings of the committee on these theoretical studies are of such a revolutionary character that the members feel the strong advisability of conducting experimental work to verify the truth thereof, as well as to make changes in furnace design and processes in order to take full advantage of the probable benefits to be gained." We agree with him.

Is a Metal Mine Safer Than a Coal Mine?

GOING HOME the other night we were attracted by the headlines over the story of the latest mine disaster at Kemmerer, Wyoming, where 97 are known to have perished in an explosion. Though the headlines that we saw did not so state, we instinctively knew that it must be a coal mine, for it has seemed to us that it is almost always in coal mines that such accidents occur. How fortunate we are to be engaged in metal mining, where we do not run such risks every time we go underground, was our thought. But turning to statistics we find that metal mining is not so much safer than coal mining after all. In one year, out of 1,000 men working full time, about 4.1 men are killed in coal mines, 3.6 in metal mines, 2.1 in quarries, 1.5 in ore-dressing plants, and 0.9 in smelters. If, as it seems, all the bad accidents are in coal mines, the number of fatalities must be offset by a larger number of small accidents in metal mines. In other words, many may get burned up, or suffocated, or blown up in a coal mine, but a stray chunk of ore will be more apt to kill you than a piece of coal.

The Central Copper Co.

FEW MINING PROMOTIONS recently have attracted more popular attention than that of the Central Copper Co., operating properties in Arizona which have previously been operated under other management without achieving success. Huge and nation-wide stock sales feature this promotion, with the novel proviso that only $100 worth of stock will be allotted to each subscriber. The plan originated with Mr. T. N. McCauley, who is the promoter and either the president or general manager of all the companies consolidated under the head of the Central Copper Co.

Examined carefully, what is the intent and effect of this $100 proviso? From the standpoint of the promoter, it would appear to be to limit the individual risk and possible loss to an insignificant sum, so that financial ruin to the small fry which so generally follows upon the heels of the type of mining speculation indulged in by this class will be impossible. Viewed in this light, it is a wise and humane proviso, and worthy of approval. But this conclusion carries the assumption of definite risk, and a definite contemplation by the promoter of the contingency of the loss of the investment, such as mining men actually know to be inherent in any development enterprise of this character; and this raises the question of the ethics of submitting shares of this kind to the general public—and the poor and needy public—for the prosperous will not bother with a $100 investment—as an alluring investment. And this is just what the promotion literature does, for it is flamboyant and excitant—it appeals to the fundamental and universal need and greed, and trades on the possible purchaser's lack of knowledge and balance, as this type of stock-selling literature always does. Altogether, we cannot but disapprove of the ethics of this school of promotion, and cannot but believe that the $100 of the poor should not be cajoled from them for mining speculation.

The question arising from this campaign has two sides and two sets of opposing opinions. Mr. McCauley has many friends of standing who believe in him and his methods. The *Arizona Mining Journal* got out a special issue for this company, in which issue the promotion of the Central Copper Co. was sandwiched throughout with ordinary Arizona news; and this is part of the campaign literature of the company. The Arizona Securities Commission approved of the promotion and the sale of stock; more than that, some of the commissioners went on record in writing, endorsing the company and its stock in positive and even extravagant terms; and their letters are also part of the company's literature. At the least, this conduct on the part of Arizona commissioners was improper. They were constituted judges, and not boosters.

On the other hand, the Michigan Securities Commission, after a thorough investigation, took a positive though unofficial stand against Mr. McCauley's application to be allowed to sell stock in Michigan; and recently much opposition to selling this stock has arisen in Pennsylvania. The *Philadelphia North American* has attacked the plan, intimating that the Federal Trade Commission would take action against it; but our Washington correspondent says that such is not the case.

As to the mine, some of our correspondents report much ore; more reliable information reports that the amount of ore that can be definitely proved and blocked out is inconsequential, and that the property is merely a prospect and must rely chiefly on the possibility that all prospects theoretically have—that of more and richer ore at greater depth. Against this showing is the total stock issue, of more than forty million dollars.

Taking it all in all, it is no wonder that financial writers like those of the *New York Tribune* advise inquirers that the stock is not to be considered in the light of an investment; more than that, it is of a peculiarly hazardous type of speculation. And when all is balanced, there must seem to the careful mining promoter or engineer a certain "ancient and fish-like smell" surrounding the whole plan. According to the law of ordinary mining speculation, the buyers of shares will probably lose their money. Is there an equivalent likelihood of the promoter incurring loss; or will he win, whether the coin falls heads or tails?

Be Sociable With Your Thoughts

THE OBSERVATION has been made that criticism of technical papers is much more the style among Englishmen than it is among Americans. Of course, such criticism depends to a certain extent upon how much effort is made to arouse it; often a reader peruses something with which he does not agree and merely dismisses the matter, with a revision downward of his opinion of the author for having written it and of the editor for having published it. But if the secretary of an institute, or the editor of a technical journal, writes to him and asks for constructive criticism, then he is more willing to offer his views. Obviously, it is impossible to request such expressions of opinion from all readers whose opinions would be worth having, so the invitation to enter the discussion column must remain largely an open one. We suggest that our subscribers, and also members of the A.I.M.E., make greater use of it. Often the general discussion of an article is more interesting than the original paper.

We suppose the chief reason why there is not more discussion, aside from human laziness, is that a reader hesitates to hurt the feelings of an author, but we believe no fair-minded author resents just criticism. If he does he should cultivate a thick skin or a hard shell, similar to that worn by editors.

Our attention was drawn to this matter by a recent paper published in the *Bulletin* of the Institution of Mining and Metallurgy, of London, entitled "Notes on the Selection of a Copper-Smelting Plant," criticism of which was somewhat more pungent than usual. We read for example, "The result of his study was disappointing. Knowing the repute of the author, and his long and successful career as a copper metallurgist, he could not but feel that he had not done justice to himself." And another member said, "whilst in general he agreed with the statements of fact, he was somewhat disappointed that the author had not dealt with his subject in greater detail, or had not, perhaps, treated it on different lines." Which, translated into colloquial English, means that he thought the author had made a rotten job of it. Again, "In the section headed 'Selection of Plant' he [the commentator] had expected to find the kernel of the paper, but the information given did not appear satisfying to the enquirer, nothing of importance being added to our knowledge."

Criticism of this kind may perhaps be a little rough, and may tend to discourage further contributions, but good constructive criticism is well worth while and should be offered more frequently than it is.

DISCUSSION

"Engineering and Mining Journal-Press" is not responsible for statements or opinions published under "Discussion." In many cases the views expressed are diametrically opposed to editorial policy and belief.

Sees Weaknesses in a Silver Export Association

Former Disastrous Attempts to Control Market Inspire Warning From Contributor

THE EDITOR:

Sir—This letter is called forth by "A Silver Export Association," discussed by Mr. Fred. H. Brownell, in the *Engineering and Mining Journal-Press*, July 7, page 17 et seq. Neither to commend nor condemn does the present writer aim; only to get at underlying facts, and open discussion which Mr. Brownell, and, so I take it, the *Journal-Press*, too, invite.

For some reason, Mr. Brownell completely ignores and skips over the foundation: *Why* an export association, and *how* build it? He assumes it already built—at a *minimum* cost of $1,750,000 a year, then asks what is it good for? His whole article answers that question along three lines, or tries to: (1) How much "production" can it control; (2) how can it "enhance and stabilize" the price of silver; (3) what financing will be necessary?

(1) *Why* the association in the first place? Just what is it that you aim at that needs an association in the particular form of an export association to control the market price, with a minimum certain cost of over $1,750,000 a year, and uncertain results—except the certain result to revive the old sore spot: Who shall control silver and the silver exchanges, London or New York?

(2) *How* will you build it—of silver miners (who produce but do not market the finished product); or of refiners, marketers, and bankers; or of a mixture?

It has been dinned into our ears for over forty years that we produce the silver in America, but London controls the market price. United States mines and American capital in Latin American and Canadian mines produce about 70 per cent of world production. Even Germany produces more silver than Britain. Then why should London control? We, because we are the producers, ought to control the price of what we produce. Hence the proposed export association to put control of the price in the hands of the producers.

Should the producer control the price of what he produces?

Should the wheat grower control the price of wheat? Should the meat packer be master of the price of meat? If they could and did, you would find the world eating more fish and other grains and potatoes, and less wheat and meat. See what happened to silver in the run-away boom market of 1919-20. The American silver producers did control then, and, by imperfect judgment, prices were permitted to soar so high as to force willy-nilly most nations of the world to demonetize silver for some coins and debase others. On the same principle many of us today have learned to get along with less meat and wheat, after the orgy of high prices—yet we seem to enjoy life, even with the Volstead Act!

Silver is more than a mere commodity. As the basis of money and China and other exchanges, it is the basis of the trade of empires. To control those exchanges and trade is a great prize. Great wars have been waged for less.

The consumers of silver present a different situation from the consumers of almost any other commodity in the world. Other consumers *always* want to buy cheap. Some of our leading silver buyers abroad *often* want big prices for silver. You can see why, when the exchange banks are "long" of Eastern exchange, or are oversold ("short") of sterling, or when the big-four among the London silver brokers (who are also dealers) are "long" as to their silver commitments.

The main joy in life for the London silver ring, so you would surmise if you listen to some Anglophobes rave, is to hammer down the price of silver against the American producer. They sit up o' nights thinking new schemes to smash silver. Pity the poor London ring! India vilifies them because it is a fact that impoverished India has not bought an ounce of silver for coinage since 1899 except at highest peak prices in the London market—save on one tiny little order in 1903. India upbraids the London ring for gouging high prices. America excoriates London for low prices. Oh for a sense of humor!

The writer asserts that the price of silver is adjudicated and fixed at London more fairly and more equitably, and more correctly matches real supply and real demand each day, than the quoted market price of almost any other important product, commodity, security, or service in the world's markets. In no other great market are bona fide buying orders and bona fide selling orders, by real buyers and real sellers, so brought together *en masse*, not a single order at a time; and so equably cleared.

America innocently tried to wrest away from London control of the world's silver market, back in 1887-1892, when we aimed to make the New York Stock Exchange the center of trading in the world of silver. The Hon. Conrad N. Jordan, ex-Treasurer of the United States, devised a scheme, which, on paper and in rhetoric, was far beyond any present-day export association plan.

There was then as now the same complaint as to fancied bear influence of London. There was then more ground for complaint than since 1896. Mr. Jordan's scheme aimed at a novel way to store silver; keep it off the market; get good prices for it, and in cash, and higher prices than London, and make the New York Stock Exchange the active market, all simultaneously. He aimed to issue against the stored silver a form of warehouse receipt, known as Silver Bullion Certificates, each good for 1,000 fine oz.

The bullion certificates were to be traded in on the New York Stock Exchange. Speculators and traders, and Exchange dealers to protect their exchange bills, would trade actively in the certificates, without intention to call for delivery of actual silver. That would result in a lively market over here, and permanently lock up much silver, off the market, warehoused against the certificates. The producer would receive cash payment by sale of his certificates. The storage thus financed itself. A further integral essential of the scheme was to promote higher prices than London. That would insure making New York *the* great market for sellers. It worked—too well. Application to list the Silver Bullion Certificates was filed May 31, 1887. The Stock Exchange listed them the next week. Trading started July 21.

The scheme won what it started out to win; but, because it won, it lost—and lost disastrously. Prices did rule higher in New York than London—so London sold to us instead of buying from us! Seligman Brothers later revealed to the Wickhan House of Representatives Committee in 1891 that France was about to unload its old silver on New York when the price decline after October, 1890, intervened. The end in 1892 was an utter fiasco. It clinched the domination of London in silver tighter than ever before. It contributed to putting India on the gold standard, so called. It precipitated a violent and lasting smash in silver.

Trading on the New York Stock Exchange in the Silver Bullion Certificates opened July 21, 1887, at 96⅜c. per oz. (actual bullion market that day 96¼c.). The week before that a convention assembled at London of the great Orient exchange banks voted to discontinue dealing in forward exchange bills beyond two months, and to standardize futures in Orient exchange, so far as expedient, to two-months' bills. That led to buying and selling silver, on a large scale, for two-months' future delivery, as a protection against exchange-bill commitments. Thus developed what has lasted to this day—namely, the great London market in two-months' future delivery, or "forward" delivery.

The big development of trading and speculation in forward silver in London since 1888 has reached such large proportions that on the floor of the House of Commons on Dec. 31, 1912, the Hon. W. Field, M.P., put the "question" to the Government: "Whether there have been any other root causes at work to account for the price depreciation (in silver) since 1888 other than the introduction into London that year" of that system of dealing in futures and options.

By the London system of dealing in futures, the price of silver for future delivery is *cheaper* than spot, or "cash" silver as London has it. The forward price is cheaper because in theory the buyer is credited with interest on his present payment up to the time of future delivery—less storage cost.

In New York spot silver ruled a little higher than London. That was due to the Stock Exchange campaign. Normally, New York is lower than London by delivery cost New York to London. On top of New York being higher than London, the Bullion Certificate on the Stock Exchange commanded half a cent an ounce, more or less, higher than the New York price of silver metal. It really cost 7 per cent to carry Bullion Certificates, including brokerage and storage. Therefore, if you bought them at 100, silver would have to go to 107, or up 7 per cent a year, before breaking even.

Who would buy a Silver Bullion Certificate to speculate with it against the future, when he could at the very start buy the actual future silver in London cheaper than spot—and minimum carrying charges? Those who really dealt in silver rushed to the London market. Too, you could buy over there interest-bearing bills on India, China, Japan, and the Straits, often paying 8 per cent, 12 per cent or more. It was like dealing in silver, and earning interest or dividends on the investment held. The New York certificate paid no dividend, and earned no interest; it *cost* interest, and a high rate, to carry. All this was brought out in 1891 by the Dingley House of Representatives committee investigating speculation in Silver Bullion Certificates. Even Senator Cameron and members of Congress who speculated in silver did so in the London market, not New York.

The New York Stock Exchange market in silver bullion certificates became a market only for the ignorant gullible. There were no trades from December, 1887, to April, 1890. Then a wild orgy of speculation broke loose in these artificially valued scraps of paper in 1890-1891 incident to the Sherman Silver Act of 1890. With 1892, trading vanished. Many years ago the certificates were sticken from the list. The ignominious failure only fastened tighter the domination of London in the world of silver and the silver exchanges.

The New York scheme resulted in putting India on a gold standard, so called, to the lasting detriment of silver. The Gladstone government, and Gladstone's Chancellor, Lord Herschell, started their India plan in 1887-1889. The Gladstone family fortunes were tied up in the India trade for generations. The Premier had a close personal interest in stability of Indian exchange, and to prevent any possibility of Indian exchange being dominated by non-English interests. That is what was bound to happen with India on a free-silver basis, and silver controlled, perhaps, from New York.

To this day British trade domination in China is largely facilitated by London controlling silver, and through silver, the silver exchanges. And because the London silver market has really been, when all is said and done, a very remarkably free, open market, with no very conspicuous manipulation, exchange dealings have been on a fair, free, open basis, best conducive to trade. Neither conducive to British trade, nor legitimate trade anywhere, would it be to have silver and the silver exchanges at the utter whim of the manager of a "blind pool" manipulating silver from New York!

It is exceedingly important to understand the viewpoint of British imperial trade, and the British desire to control or at least guarantee the openness of certain silver exchanges, via the London open bullion market.

Why is it that London exercises control of the world's silver market, and the silver exchanges? It is not the "flimsy" reasons, true they all be, that the biggest customers reside there—the Secretary of State for India, and the Exchange Banks, and the Royal Mint, and the great brokerage concerns (who are dealers as well as brokers)—and that the Continent, too, came there to buy—and since 1919 to sell. All those customers for silver could as easily buy at New York by cabled orders, as regards silver itself, if it were possible to divorce silver from silver exchanges. They do buy silver from New York, by cable, in part.

The real reasons for control at London have to do, first, with the machinery of cheap money and cheap banking credit at London. The London rate for the use of money is 2 per cent or more cheaper than New

York, to the public, and 2½ per cent or more cheaper in London to British bankers. This is an inestimable benefit to bankers, dealers, and traders who must carry either silver, or carry eastern exchange transactions. That is chiefly what makes the world come to London.

Then a second reason for London domination has to do with the machinery of exchange control by the India Office and the Eastern Exchange Banks, and the cables. The tremendous volume of eastern exchange transactions via London and at London requires a tremendous volume of covering trades in silver to protect exchange-bill commitments. It is vital to British trade in the East, and vital to stability of the silver exchanges, that a free and open market exist for silver, relatively free from untoward and uncontrollable manipulation by any outsider. That makes it highly desirable, from the British viewpoint, to keep the market free and open—and at London.

Thirdly, the efficient machinery of London silver brokerage technic helps keep control at London. Of the Big Four, the youngest house, Samuel Montagu, has been in business nearly 75 years. The oldest, Mocatta & Goldsmid, nearly 275 years. They have mastered many tricks of the trade. They are big bankers, and dealers, as well as brokers, and they operate heavily not only in silver, but as well in gold, and in exchange bills. More, and still more—they are indissolubly linked with the political regime of the British Empire. The senior house acts as official agent for the Bank of England. The junior house is a great political factor in Britain. The senior partner, Lord Swaythling, sits in the House of Lords (the founder, Moses Samuel, who changed his name to Samuel Montagu, became the first Lord Swaythling). His younger brother, the Hon. Edwin P. Montagu, sat in the British Cabinet from 1917-1922 as Secretary of State for India, and has been Parliamentary Under-Secretary of State for India since 1906, in the House of Commons. Their close friend, Earl Reading, is Viceroy of India and was Attorney General and Lord Chief Justice. Sir Stuart Samuel, of the firm, sat in the House of Commons, and his brother, Sir Herbert Samuel, was Postmaster General, and since the war, mandate Commissioner of Palestine.

It is those three machinery appliances—cheap money rates, exchange centralization, and superlative brokerage organization (largely the first) that made, make, keep and will keep London in control of the world's silver market. Her imperial trade necessities require that she keep a grip on the silver exchanges, via silver. Similarly, the London market rules wheat, cotton, and other commodities which Britain does not produce, but which the machinery of British finance and cheap money permit Britain to "carry," and dominate.

How can our association in New York, as proposed, take those things away from London?

And even if it could, and did, wrest from London domination in silver and the exchanges, how long, now, do you suppose Britain would calmly acquiesce in the further continuation of free-silverism in Hongkong and China, if silver be under non-British control? Remember what Gladstone and Herschell did to the silver standard in India when New York merely threatened to fight for control. Remember, too, that the charter revision of the Hongkong and Shanghai Banking Corporation in 1922 already paves the way to abandon the silver standard in Hongkong, if this be deemed desirable. Remember, too, there have been several battles to install in China a gold standard.

This talk of fighting London for the purpose of bringing to New York control of silver and the silver exchanges, and to do it with such an instrument as a proposed silver export association of American mines and producers, whose purposes and methods since 1874 have never changed, is bound to harm silver. History proves that silver's worst foes have been, whom do you suppose? Its friends: but friends who were misguided, and builded on an uncertain foundation of facts. They did a lot of mischief in 1887-1892 to silver, from which silver has never recovered. They did more in the winter of 1919-1920. Misguided effort built on wrong premises may, conceivably, lead to a "knockout" in few years.

Mr. Brownell in his article suggests co-operating with London, rather than fighting London domination.

This must come as a profound shock to most western mining interests who for forty years have always understood that the only *raison d'être* for New York to control silver is to wrest domination away from wicked London, and that the producer ought by right to control the market price of what he produces. I will pass hurriedly without comment over the point whether, if a New York association of that kind ruled, would the producer really control the price of what he produces as much or as well as now London does? Would such an association at New York be on the level, and could it continue on the level, in its protestations of friendship and co-operation with London, and what is most important, would London believe and acquiesce? Perhaps—But:

Many in the City (London) who, by the way, cut their eye-teeth long before the day before yesterday, may be excused for a little backwardness in coming forward, and being the first, at last, to accept Mr. Brownell's hints of friendship in the same co-operative spirit that this brilliant lawyer invites the London cat to step into the bag—with the strings held at New York.

New York. CARPEL L. BREGER.

Speed of Moving Men in Mine Shafts

THE EDITOR:

Sir—In looking through your July 7 issue, I noticed on page 15 an article entitled "Speed of Moving Men in Mine Shafts," by M. W. von Bernewitz, in which he raised some controversy as to certain supposed statements by Mr. H. D. James, manager of the control engineering department of the Westinghouse company. It appears that Mr. von Bernewitz is raising somewhat of a tempest over a complete misunderstanding of Mr. James' statements and recommendations as to the particular subject under discussion.

Referring to the April 19, 1923, issue of the *Proceedings* of the Engineers' Society of Western Pennsylvania, which is a stenographic report of the meeting to which Mr. von Bernewitz refers and which he attended, you will note on pages 94 and 95 the report of that part of the discussion referring to mine hoist speeds. Mr. James states that mine hoists do operate at 3,000 ft. per minute, but does not state that they carry men at this speed. He also specifically limits his recommended speed to 1,000 ft. It appears, therefore, that the representations in the article referred to in your magazine were quite unnecessary and were unfortunate.

East Pittsburgh, Pa. J. C. MCQUISTON.

[Mr. McQuiston is correct. The printed record of the *Proceedings* of the meeting referred to supports his statement.—Editor.]

Mining Engineers of Note

SEELEY W. MUDD

JUST THE OTHER DAY, Seeley W. Mudd celebrated his sixty-second birthday anniversary, he having been born at Kirkwood, Mo., on Aug. 16, 1861. Were he in the United States Army or Navy he would have only two years more of active duty before being automatically placed on the retired list, but fortunately he is not in work of that kind, and the mining industry may expect constructive work from Mr. Mudd for many years to come. All of his life has been devoted to mining, he having chosen that profession when he went to Washington University, of St. Louis, from which he graduated with the degree of Engineer of Mines in 1883. Pope Yeatman was a classmate. After graduation, as so often happens, a job was the first consideration, so along with several of his fellows he went to Ste. Genevieve, Mo., working about a small copper smelter for a few months. Then he accepted a position as assayer at $60 per month at the lead smelter of the St. Louis Smelting & Refining Co. We have heard it said that an assayer should never show unusual ability, for if he does he will be too valuable ever to be replaced and will be kept at the job for life—truly a grievous prospect. It might have been that Mr. Mudd understood this and was accordingly a poor assayer. We suspect, however, that it was his previous experience around a copper furnace that led his new employers to have him help with and later take charge of a copper reverberatory furnace that was being erected. A small electrolytic refinery was also built, though electrolytic copper was still a comparatively rare article. At the end of two years and a half Leadville, Colo., looked attractive, and Mr. Mudd had an opportunity to work at the Small Hopes mine, a bonanza property, at which a friend, C. M. Donaldson, had just been made manager. When Mr. Donaldson left in 1887 to go to Oregon, Mr. Mudd became manager, and in the same year he was also married. The bonanza ore in the Small Hopes mine was soon exhausted, but the company continued operations until 1912, leasing of neighboring ground being resorted to help keep the wolf from the door. In working these leases, and consolidating them, Mr. Mudd received much valuable experience on the economic side of a mining operation. Although Mr. Mudd was connected with the Small Hopes mine for twenty-five years, the health of one of his children necessitated the removal of his residence to the Coast, so in 1901 he went to Los Angeles, where he still lives. For a year or two, though, he spent much of his time in Colorado, being consulting engineer for the New Jersey Zinc Co. in addition to his several other interests. Then he became consulting engineer on the Pacific Coast for the Guggenheim Exploration Co. and brought that company's attention to the Dairy Farm property, in California, and to the Utah Copper deposit in Bingham Canyon. He resigned in 1905, and in 1907 was actively associated in the development of the Ray Consolidated as a large producer of low-grade ore. Since then, Mr. Mudd has been doing general examination and consulting work and has spent a large amount of time in seeking out desirable properties and studying and suggesting improved equipment. One of his most interesting experiences was in connection with the United Eastern property at Oatman, Ariz. This seemed like nothing more than a promising wildcat at first, as in this district there is little surface indication of ore at depth. But at 200 ft. the shaft struck about 25 ft. of $25 ore, and profits mounted up to well over a million dollars a year. Mr. Mudd was also connected with the early development of what is now known as the Texas Gulf Sulphur Co. The World War threw Mr. Mudd into a different line of work, as it did so many others, he being assistant director, under D. C. Jackling, of United States explosives plants. From this work he was discharged in 1919 with the rank of colonel, since when he has resumed his consulting work in Los Angeles. One of Mr. Mudd's sons is "following in father's footsteps," he having been graduated from Columbia in 1912; the other is a doctor of medicine. Mr. Mudd is a member of the A.I.M.E. and other technical societies, and his name is on the roster of several clubs devoted to outdoor sports.

SEELEY W. MUDD

Douglas Fir for Mine Timbers*

Facts About an Important Product of the Pacific Slope

By C. J. Hogue
Manager West Coast Forest Products Bureau, Seattle and New York

IT IS THE PURPOSE of this article to present information on Douglas fir rather than to make definite recommendations as to its use. Douglas fir is a species of timber of prime importance in mine timbering. Given the physical and mechanical properties of the wood and a description of its commercial grades, the mining engineer or superintendent of construction will be far better able to select the best grade for his purpose than I would be to recommend it.

The grade required depends on the use, the strength required and the period of use, so different grades will be required in different parts of the mining operation. Many times a better grade than is necessary is used. On the other hand, as timber increases in cost a tendency is noticed to use higher grades of timber in order to get longer serviceable life, and to give timber intended for permanent use preservative treatment.

Great Pacific Douglas Fir Forests

The Douglas fir forests lie along the shores of the Pacific Ocean through Oregon and Washington into southern British Columbia and extend to the east to the crest of the Cascade Range. The wood is also found in the Rocky Mountains and, to some extent, in the intermountain region between the Rockies and the west coast, but the growth is of smaller size and inferior quality to that of the west coast region of western Oregon and Washington. The United States Forest Service makes the locality distinction of "Coast" or "West Coast" type and "Mountain" or "Rocky Mountain" type.

Douglas fir represents about one-fourth of the standing timber in the United States. The trees of the west coast region are of great size and height and the stand of timber is dense, averaging about four times as much per acre as the average for the country as a whole.

No other American wood is suitable for so wide a range of uses as Douglas fir, with its variety of material, ranging from the fine-grained, soft, old-growth wood of the finish lumber to the hard, tough wood of the structural timber, excelled in strength by no other soft-wood species.

The suitability of the wood for various uses is associated largely with its rate of growth. In a large old-growth tree the grain is quite coarse at the center, the rate of growth becoming increasingly slower as the tree becomes older. The fine-grained wood of the outer part of the tree is soft and of uniform texture, and is easily worked with tools. The wood of medium or normal rate of growth is hard, tough and strong, and is the structural type. The coarse-grained wood of the heart of the tree is suitable for general use for boards, studding, joists and other purposes. In smaller trees the rate of growth is more uniform, being sometimes of the structural type throughout and sometimes in fast-growing trees, of the coarser type.

Douglas fir may be red or yellow. Color seems to be associated mainly with rate of growth. Fast-growing wood is red; slow-growing wood is yellow. Both colors will be found in the big old trees, the coarse-grained wood of the center being red and the color gradually changing to yellow as the grain becomes finer. Smaller trees will be red or yellow throughout, depending on the rate of growth. No difference in strength can be noted between red fir and yellow fir of otherwise equivalent character.

Douglas Fir Has Great Strength and Light Weight

The two species of wood principally used for structural purposes are Douglas fir, or Oregon pine as it is largely known abroad, and yellow pine from the southern states.

In comparison of the two woods, Technical Note 119 of the Forest Products Laboratory of the United States Forest Service, says:

"There is little difference between the strength of the southern pines and that of Douglas fir from the Pacific Northwest, tests made at the United States Forest Products Laboratory show. As far as strength properties are concerned, the choice between any two lots of southern pine and Douglas fir will depend upon the grade and density of the timber composing each lot."

Dr. Harry P. Brown, wood technologist, in a discussion at the New York State College of Forestry, said, with reference to Douglas fir and the southern yellow pines:

"There is no difference between the strength equivalents of pine and Douglas fir. Small pieces in green or air-dried condition seem to give southern pine a slight preference, but tests of timbers (stringers) of structural size

*The *Journal-Press* presents this article to its readers with the idea that they will want to read what one interested in the lumber industry has to say about this important mine supply.

indicate that Douglas fir is the stronger and stiffer wood when used in structural sizes."

Douglas fir is one of the strongest and stiffest soft woods in the United States and in comparable grades with any other species it has no superior. It has, as a fact, materially greater strength than the average wood of its weight and equal strength with much heavier woods. This is one of its greatest values: its great strength compared with its light weight.

It may be obtained in any size or length likely to be required. Timbers 20x20 and 120 ft. long can be cut, as can also pieces 30x30 and 80 to 100 ft. long, or huge dredge spuds up to 3 ft. square and 60 ft. long: timbers obtainable nowhere else in the United States.

Douglas fir may be divided broadly into several types: The typical old-growth tree already mentioned; the small yellow close-grained fir, a tree that may not exceed 24 to 30 in. in diameter; and between these two types the coarser-grained large red fir; a tree that grows to a diameter of 48 to 60 in.

Douglas Fir Durable

Douglas fir stands high in the list of woods in resistance to decay. The most resistant are, of course, western red cedar, Port Orford cedar, redwood, and heart cypress. Next to these come Douglas fir and longleaf pine; then spruce, hemlock, and the other species of pine.

Material from any species of wood varies in character, and also in durability, according as it is wood of normal growth, or of a rapid growth, light-weight type, and particularly according to whether it is heartwood or sapwood. It also varies in durability according to different conditions of exposure.

The Forest Products Laboratory of the U. S. Forest Service, in a technical note on the relative durability of various species of wood, says:

"Bald cypress, redwood and most of the cedars are highly durable species. Douglas fir, longleaf pine, the white pines and western larch average only a little less durable than white oak. Hemlock, the true firs, and loblolly, lodgepole and western yellow pine fall considerably lower. The sapwood of practically all species has very low durability."

One of the distinctive features of Douglas fir is its thin ring of sapwood, averaging not more than 2 in. thick in a 48-in. log. This makes it easy to get structural timbers of 100 per cent heart face as well as unlikely that they will have any considerable amount of sap because the sapwood is more valuable in clear cuttings, and timber would usually be cut entirely inside the sap.

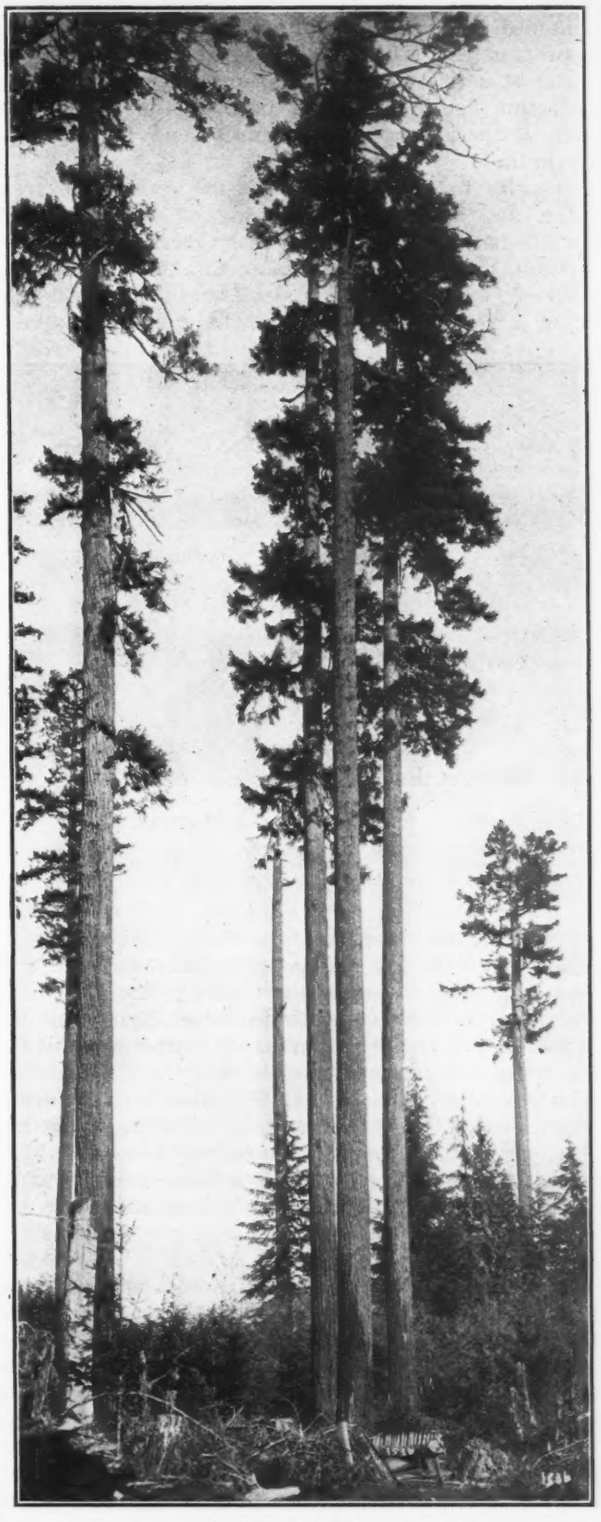
Heartwood is more durable than sapwood, and the thin sap ring of Douglas fir is a feature which makes it of great value for use in mines where the conditions are conducive to decay and the most resistant wood is desirable.

Preservative Treatment Prevents Decay

To prevent decay of mine timbers the use of wood treated with one of the standard preservatives, coal tar, creosote or zinc chloride, is often economical. To be effective the preservative must penetrate the wood, and the proper penetration of timber is obtained by the use of pressure. By pressure processes the penetration of the preservative is subject to control so that the amount of preservative and the penetration may be varied to suit the different requirements and thus result in an economic use of the preservative.

Pressure treatments are grouped in two classes: (1) Full-cell process, the object of which is to fill the intercellular spaces of the wood as completely as possible with the preservative; and (2) the empty-cell process, the object of which is to secure as thorough and deep a penetration as possible with the use of a minimum quantity of preservative.

About 10 to 12 lb. of creosote per cubic foot is usually forced into Douglas fir when the full-cell process is



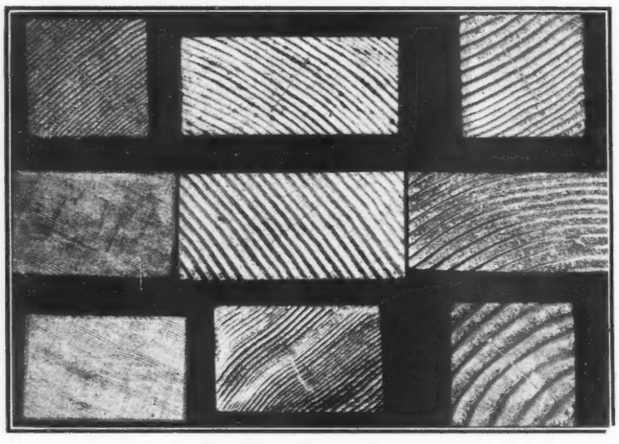
A group of giants

Douglas fir 6 ft. in diameter and standing 250 ft. high.

used, compared with approximately 6 to 10 lb. by the use of the empty-cell process. When zinc chloride is used the standard practice is to inject about one-half pound of the dry salt per cubic foot of timber. Timber treated by either of the above processes will give long service and the treatment to use depends upon conditions at each individual mine.

The strength of timber is not appreciably affected by proper preservative treatment. The timber may be green or seasoned. If green, Douglas fir is usually seasoned for treatment by boiling under a vacuum at approximately 180 deg. F., thereby evaporating the water at a relatively low temperature, with consequent reduction in the danger of injury to the wood, since high temperatures and pressures tend to reduce its strength.

Douglas fir is quite resistant to preservative treatment, and a method of incising or perforating the surface has lately been devised, by means of which the creosote more easily penetrates to the desired depth. This surface perforation is also found to have a decided effect in reducing seasoning checking, or at least in so



Sections of various grades, showing grain

Douglas fir affords material for almost all requirements, ranging from light construction lumber through hard and strong structural timber to soft, easily worked, close-textured woods.

distributing the checks as to prevent concentration in a few large checks, and so materially reducing the weakening effect of seasoning checks. The weakening effect of the surface perforations is slight, and the method can be applied to untreated timber also for the purpose of reducing checking damage.

The greatest danger to treated timber is in the development of additional season checks after treatment has been completed, exposing untreated wood to decay. The uniform temperature and damp atmosphere of a mine would reduce this possibility to a minimum.

Treatment Cheaper in End

Treated mine timbers at most would not cost more than twice as much as untreated timber and would last several times as long. They would, therefore, be lower in cost than replacement. An additional advantage would be the avoidance of interruption in a project in which continuity of operation was of importance.

Grades of Douglas fir bought for mine timbers vary from a high type of Selected Common for permanent framing sets to a No. 3 Common for logging to serve a temporary purpose and be left in the mine when the drift is worked out.

The standard grade of Douglas fir mine timbers, and one which has given general satisfaction, is called "Mining" grade and is specified as follows:

This grade shall consist of lumber free from serious shake, splits or rot. Will allow variations in sawing; sap stain; solid heart stain extending over not more than half of the piece; large knots; a few well scattered worm holes; and wane 3 in. on one corner or its equivalent on two or more corners. Will admit fifteen per cent West Coast hemlock.

This grade compares in general with a No. 2 Common, although in sound timber larger defects would not be an objection. When large quantities of timbers are bought they are often graded on a broad interpretation of the rule, the timber being sorted afterward and the better pieces being used for the more important purposes and the poorer for blocking or wedges and miscellaneous use.

When timbers of good structural value are required, they are specified when buying as No. 1 Common timbers for posts, braces and caps, and No. 1 Common stringers for stringers, lintels, girders, beams and heavy joists. Specifications for No. 1 Common timbers and No. 1 Common stringers are as follows:

No. 1 Common timbers shall be sound stock, well manufactured, and free from defects that will materially weaken the piece. Occasional slight variation in sawing allowed. 10x10 timbers may have 2-in. wane on one corner or the equivalent on two or more corners. Smaller and larger timbers may have wane in proportion. In addition will allow: Large, sound and tight knots which approximately should not be more than one-fourth the width in diameter of any one side in which they may appear; spike knots; checks and season checks not extending over one-eighth the length of the piece; stained sap one-third the width and slight streak of heart stain extending not more than one-fourth the length of the piece.

No. 1 Common stringers must be well manufactured and free from defects that materially weaken the strength. Will allow slight variation in sawing; pitch pockets; sap one-third the width and one-fourth the thickness; sound knots, if not in clusters, not exceeding in diameter 2 in. on edges or corners of side faces, increasing in diameter to a maximum size along the center lines of the wide faces of one-fourth the width of the face in which they appear; diameter of knots to be measured on the mean or average diameter.

When structural timbers of the highest grade are required for permanent work, they are specified in ordering as "selected common structural grade for posts, braces and caps," and "selected common stringer grade for stringers, lintels, girders, beams and heavy joist." The requirements for these two grades are as follows:

Selected common structural shall be sound, strong lumber of medium rate of growth as defined in paragraph 173 (below); well manufactured to sizes ordered; occasional slight variation in sawing permitted; free from shake, cross or spiral grain or defects that materially impair the strength of the piece, and must be suitable for high class structural purposes or the purpose for which it is intended, including bridge timbers, ship timbers, heavy mill construction, etc. Will permit pitch pockets and sound and tight knots if not in clusters, if not exceeding in diameter one-sixth the width of the side in which they occur up to and including 12x12, and in no case exceeding 2½ in. in diameter in sizes larger than 12x12.

Selected common stringers must be square-edged, free from shake, cross or spiral grain or defects that materially impair the strength of the piece and shall be of medium rate of growth as defined in paragraph 173 (below). Will allow occasional slight variation in sawing; medium pitch pockets; sap not to exceed 3 in. on face or 2 in. on edges at widest point; sound and tight knots if not in clusters and not exceeding in diameter 1½ in. on edges or corners.

of wide faces, increasing in diameter to a maximum size of 3 in. along the center line of the wide faces. The diameter of a knot on an edge shall be taken as the maximum width of the edge covered by the knot; on a wide face, as the smallest diameetr of the knot.

Paragraph 173

Medium rate of growth shall mean an average of not less than six rings per inch measured over a 3-in. line across the grain. In side-cut pieces the 3-in. line shall be measured over the coarsest part. In boxed heart pieces it shall be measured over the third, fourth and fifth inches from the pith or heart center, beginning 2 in. from the pith, on a line extending from the pith to the farthest corner.

The following grades are as given in Rail 2 Standard Classification, Grading and Dressing Rules of the West Coast Lumbermen's Association:

Mining Timber	Page 20, Paragraph 154
No. 1 Common Timbers	Page 19, Paragraph 151
No. 1 Common Stringers	Page 24, Paragraph 181
Selected Common Structural	Page 23, Paragraph 178
Selected Common Stringers	Page 24, Paragraph 180

The "Mining Timber" grade is practically the same as the grades of that name in Domestic List No. 7 for domestic cargo shipments and Export List K for export shipment, published by the Pacific Lumber Inspection Bureau.

The following average physical properties of Douglas fir are given in Bulletin 556 of the U. S. Department of Agriculture, "Mechanical Properties of Woods Grown in the United States":

Specific gravity, oven-dry (based on volume when green)	.45
Moisture content, green, p r cent (per cent of weight of oven-dry weight of wood)	36
Weight per cubic foot, green, lb	38
Shrinkage from green to oven-dry condition (per cent of dimensions, green)	
Radial, per cent	5.0
Tangential, per cent	7.9
Volumetric, per cent	12.6

The following working stresses per square inch are recommended for the structural grades, based on the relations of defects to strength as found at the Forest Products Laboratory of the United States Forest Service:

	Extreme Fibre Bending	Shear Maximum	Modulus of Elasticity	Strut or Column	Side Compression (Bearing)
No. 1 Common Timbers	.....	.....	1,600,000	800	215
No. 1 Common Stringers	1,200	70	1,600,000	.....	260
Selected Common Structural	.....	..	1,600,000	1,100	350
Selected Common Stringers	1,600	95	1,600,000	.....	350

These values are for use where the timbers are continually dry. For exposed exterior use or where used in conditions of continued heavy dampness, reductions up to the following percentages should be made: Bending, extreme fiber, 15 per cent; strut or column, 10 per cent; side compression, 25 per cent.

Mineral Crystals for Radio Receiving Circuits

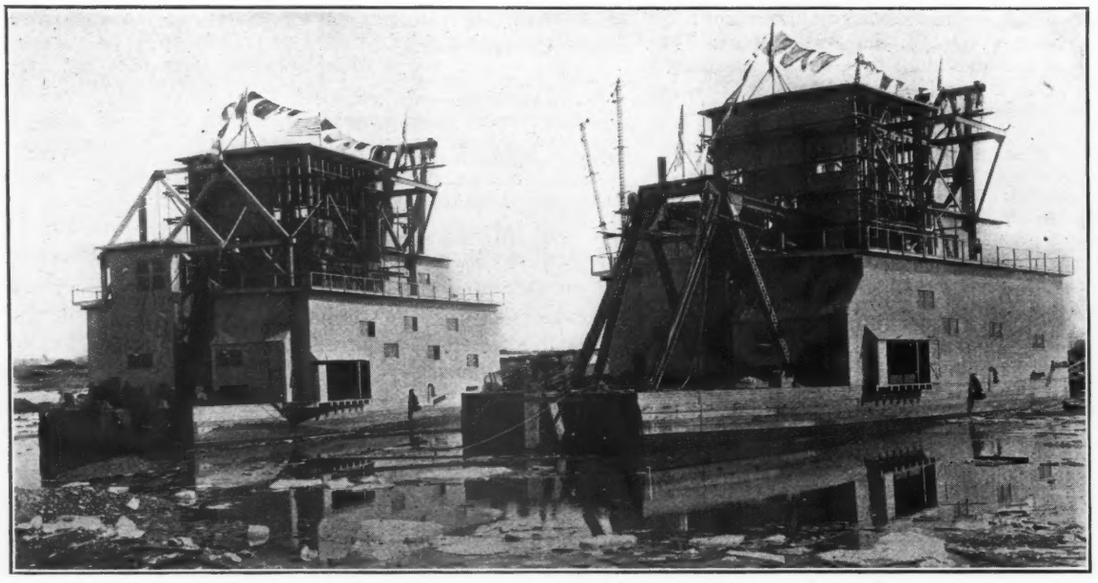
MINERAL CRYSTALS have been used to a large extent in cheap wireless receiving sets where the signals or broadcasting come from stations not more than twenty-five miles away. Such crystals have the property of transmitting a weak electric current in one direction only; they rectify the high-frequency oscillating currents induced in the receiving circuit and produce pulsations of current in one direction only which can be made audible in a telephone receiver.

A large number of crystals possess the qualities necessary for rectification, says a writer in the *Mining Journal*; some in positive, others in a negative direction. Among the more commonly used minerals are zincite, chalcopyrite, bornite, pyrite, galena, molybdenite, graphite, octahedrite, cerussite, and hessite, etc. In addition to natural minerals, some artificially prepared substances have also been successfully applied for the same purpose. In this group come the various kinds of picked specimens of green and black crystalline carborundum. This material requires the assistance of a local battery to increase its sensitiveness. It is, perhaps, needless to say that there are also a large number of "crystals" possessing trade names, but these in most cases are one or other of the minerals named above. Sometimes such mineral fragments are carefully tested, prepared, and suitably mounted, and a further name given to the apparatus so constructed.

All these substances are not equally efficient in the work they are utilized for as rectifiers of oscillating currents of high frequency. Their characteristics vary greatly; some are better than others, but the sensitiveness of a single fragment may be very different at different points on its surface, and except by trial it is difficult to tell whether a flake of molybdenite will be more sensitive than a fragment of zincite, although the latter is normally considered the more sensitive crystal.

The general procedure is to mount the mineral fragment with an alloy of very low melting-point (Wood's metal) in a small metal cup. This cup forms part of the receiving circuit on one side, while a fine metallic wire in light contact with the "crystal" surface effects continuity of circuit on the other.

From a knowledge of the minerals mentioned it is difficult to offer a convincing explanation of the phenomena observed. The mineral molybdenite is strongly negative in action, while zincite is strongly positive, and galena is practically neutral. Some think the rectifying effect is dependent on the position of the metallic constituent of the mineral in the electromotive series of the metals—the order of the common metals, from the positive end, being zinc, tin, lead, iron, antimony, copper, silver, and some other minerals and metals, to graphite at the electronegative end. The available experimental evidence is exceedingly inadequate, and a considerable amount of work must yet be done before a satisfactory solution of the phenomena is obtained. Although a great deal obviously depends on the chemical composition of the mineral, there is little doubt that crystal structure and molecular grouping must play a very important part in determining this characteristic of these minerals. And yet it must be remembered that "contact" of "crystal on crystal," or "a metal point on crystal," looms very large, and early experiments with Hertzian waves come to mind. Textbooks on mineralogy are silent on the subject. Such substances as pitchblende, columbite, tantalite, samarskite, and monazite, would appear to be peculiarly suitable for the purpose of rectifying high-frequency oscillating currents. Although rare, they should not be expensive, and the results of tests are sure to be interesting, and may possibly result in an appreciable increase in the range of small "crystal" receiving sets, or in obtaining clearer, louder signals from existing transmitting stations.



Nome No. 1 and Nome No. 2 dredges of the Hammon Consolidated Gold Fields after launching at Nome, Alaska, on June 1, 1923

New Dredges Now Running at Nome

ON JUNE 1, 1923, Nome No. 1 and Nome No. 2 gold dredges, constructed by the Yuba Manufacturing Co. at Nome, Alaska, for the Hammon Consolidated Gold Fields, were launched in an advanced state of completion. Both dredges were rapidly completed and were turned over to the operating company about July 1, 1923, and were soon thereafter placed in operation and are now working successfully. Two clean-ups have been made on one boat and one clean-up has been made on the other. The results have not been announced, but it is understood that they are satisfactory.

The dredges were shipped to Nome in a single shipment in August, 1922, and erection began as soon as the material was received. The winter was normal, although there were a few severe storms. The maximum number of men on the erecting crew at one time was ninety, of these about two-thirds were from the outside and one-third was recruited locally. As the operating season is confined to about five months, it was necessary to have the dredges ready at the opening of the season in July. The company hopes to extend the usual working season to six or seven months. The outcome of this is largely dependent upon the water supply. The ground for one year's operation will be thawed during the preceding year. At the time of launching the ice in the dredge pond was blasted and hydraulicked to make room for the boats. By means of the derrick some of the ice was removed from the pond and stacked on one side. The launching was made a local event, the Mayor of Nome declaring a holiday, and all of the inhabitants attended.

The dredges are of standard construction, but are especially housed and heated. The housing is fireproof and is constructed of an outer layer of 20-gage steel, an inner layer of 22-gage steel and a ¼-in. layer of "amiwood" between. A boiler with steam-heating pipes is installed on each dredge. The dredges are electrically operated. As an abnormal amount of sand and muck must be handled, special sand wheels are provided, which pick up the discharge from the sluices and elevate it to a conveyor which discharges upon the stacker belt. Labor and transportation costs during erection were more than had been estimated, but the results justified the undertaking, particularly in the case of a new company operating under the conditions of an extremely short working season. Other details of the dredge and power plants are as follows:

Both dredges are alike in practically all of their details, excepting that one is designed for a digging depth of 60 ft. and the other for 40 ft. The hull trusses and gauntries are of steel construction, and the bottom, sides, and decks of the hulls are of wood, as wood will better withstand freezing and water conditions. This composite type of hull construction is considered to be better engineering than an all-steel hull.

The dredges have 9-cu.ft. buckets, and are expected to dig 6,000 cu.yd. per twenty-four-hour operating day. The monthly output anticipated is 200,000 cu.yd. The buckets are of manganese steel, with bottom and hood cast integrally. A plain outside lip is riveted to the bucket and the bucket line is close connected.

Because of the clay and muck in the gravel, the screening area is larger than that usually provided. It totals 900 sq.ft. in area, the dimensions of the revolving screen being 9 ft. in diameter by 39 ft. in length. Screen openings are ½ to ⅝ and ⅜ to ½ in., tapered hole. Screen plates are of high-carbon rolled steel. The holes are drilled and tapered. One stacker is 160 ft. long; the other 142 ft. The conveyor belt is 36 in. in width. The gold-saving table area will be 4,400 sq.ft. The main drive is equipped with a 250-hp. motor; the pumps have motors aggregating 150 hp., and the total motor horsepower provided for each dredge is 602. The dredges in design and equipment embody all of the best features in dredge construction.

Power is transmitted over a 3½-mile line to the dredges. The plant consists of three 525-hp. Werkspoor full Diesel engines and three 538-kva. General Electric generators directly connected to the engines, which supply 2,200-volt current. This voltage is stepped up by transformers to 11,000 volts for transmission to the dredges. Oil storage consists of a 25,000-bbl. steel tank and a smaller steel tank of sufficient capacity for one day's operation inside the power house. The power plant consists of a wooden frame building with a wooden roof covered with corrugated steel. The inside of the building is lined with "amiwood." The foundation for the engines, motors, and the building is of concrete.

Progressive Enrichment of Zinc Chats With Decreasing Size*

Old Theory of "Once a Chat Always a Chat" No Longer Tenable in the Light of Recent Investigations

By Will H. Coghill and C. O. Anderson
Metallurgist, and Assistant Metallurgist, U. S. Bureau of Mines

THE BASIC PROBLEM in the concentration of the Tri-State ores of Oklahoma, Kansas, and Missouri is the separation of blende from flint. Associated minerals, such as galena, pyrite, marcasite, lime, and clay, may be present, but they are of secondary importance in the milling problem and are not considered in this discussion.

One of the best-known facts about the district is that far too much zinc is lost in the mill tailing; another important fact, not commonly known, is that the district seldom, if ever, affords an opportunity for a metallurgist to give his undivided attention to research for a long period. Funds supplied by the U. S. Bureau of Mines and by certain of the operators, together with the genuine co-operation of many of the operators, have given the writers an unusual opportunity for research. Certain conclusions were reached and some of these conclusions have been published.[1]

The subject treated in this paper is primarily the breaking of locked grains of blende and flint when chats[2] are crushed in rolls. Present practice has been justified by what is really a wrong conception of the nature of the grains formed by further breaking of a chat containing around 10 per cent blende. A common saying in the district is, "Once a chat always a chat," meaning thereby that when a chat is broken no enriched grains are liberated. This statement is in error. To be sure, a rigid application of petrographic methods would lead to the conclusion that locking extends beyond 100 mesh, but regarded in the light of practical milling experience it is known that chats disappear at 35 mesh, being, in fact, replaced by free blende and free flint.

Fine Grinding of Entire Mill Feed Is Passing

The old school of metallurgy that advocated crushing the mill feed fine enough to unlock every grain is passing. It reigned supreme in the Tri-State zinc district during the late boom period, causing abnormal loss of mineral and excessive operating expenses. The metallurgist should remember that the concentration of the gangue should receive equal attention with the concentration of the mineral; that is to say, concentration should begin at the point where crushing has liberated a goodly part of the gangue. Fortunately, in the Tri-State district the pendulum has swung in the direction of coarser crushing at the head of the mill.

In an unsized chat product the fine chat grains will be far richer than the coarse grains. For instance, grains crushed to 20-mesh size are found to be richer than grains crushed to ¼-in. size; similarly, the average analysis of ⅛-in. chats exceeds the average of ¼-in. chats in the same mixture. Ample evidence in support of this statement will be presented.

The crude ore is crushed at the head of the mills to pass through about a $\frac{7}{16}$-in. ring (in former practice, such as during the World War, it was finer); therefore the locked grains under consideration range in diameter from $\frac{7}{16}$-in. downward. The blende and the flint are cemented firmly together, so that liberation of mineral is not easy. Some chats are drawn on the rougher jig and reground to recover the contained mineral, but those chats which evade the chat draws and pass into the tailing have been regarded too lightly; operators in general consider the mineral locked in the chats which escaped with the tailing as non-recoverable. If it were a fact that a chat remains a chat, no matter to what fineness it may be crushed, then the point of liberation would never be reached and the opinion already stated would be correct. But, as set forth above, our observation is that the vanishing point of chats is at about 35 mesh.

When chat grains are struck by the rolls a majority of the grains liberate free flint, free mineral, and pieces of chats, many of which are richer than the original chat grains. The grade of the chat grains of any particular size ranges all the way from free flint to completely liberated blende. However, the grade of the average chat grains progressively increases from the coarsest down to the size where chats become very rich and disappear. When a given chat product is broken, as in rolls, the zinc tenor of the coarsest chat in the resulting product is less than that of any of the smaller sizes of chats. The zinc tenor of any particular size of chats in a given product is greater than that of any larger size and less than that of any smaller size. We obtained the zinc tenor of the average chats of any particular size by sizing a crushed product and then hand-sorting out a chat product from each individual size. As the minerals are easily identified, it was possible to make a definite separation.

An Example of Chat Enrichment

What has been said about progressive enrichment of chats may be generalized in the following manner: Two minerals, *A* and *B*, form a locked *AB*. Crushing will liberate a part of *A* and a part of *B*, while a part of the original *AB* remains. Thus, two possibilities present themselves: products having *AB* enriched in *A*, and products having *AB* enriched in *B*. When *AB* is enriched in *A* a relatively large amount of *B* results, and when *AB* is enriched in *B* a relatively large amount of *A* results. In the case under consideration *AB* is enriched in the economic mineral, resulting in the liberation of a relatively large amount of the gangue. This study opens a field of research that should be extended to other mining districts.

An assortment of chat grains (no free flint or free blende present) of approximately $\frac{7}{16}$ in. diameter, containing 2.90 per cent zinc (4.35 per cent blende) was divided into two lots. The first was crushed in laboratory rolls to pass ¼ in. and the second to pass ⅛ in. (The grinding was performed by stages in spaced rolls supplied through the courtesy of Waring & Williams,

*Published by permission of the Director, Bureau of Mines, Department of the Interior.

[1] "Engineer's Report on Milling Methods," Annual Mining Number *Joplin Globe*, January, 1922.
"Coarser Grinding Would Help District," Annual Mining Number *Joplin Globe*, January, 1923.
"Premiums and Penalties on Tri-State Zinc Ores," *Bulletin* American Zinc Institute, Vol. 5, No. 12, December, 1922, p. 12.

[2] The local term for grains containing both gangue and mineral and usually discarded.

of Joplin, Mo.) The results are shown in Tables I and II. Each product after grinding was screened into a number of sizes (first column of the tables) and from each size was hand-sorted a chat product and a free flint product. Each chat product was analyzed, and the last column in the tables gives the zinc tenor of the average chats of that particular size.

Table I—Chats Crushed to Pass ¼ in. to Show Progressive Enrichment of the Chat Grains With Decreasing Size

Product Size	Ratio of Free Flint to Chats	Per Cent Zinc of Average Chat Grain
— ¼ in. + 7/16 in.	0.64 to 1.0	4.01
—7/16 in. + 6 mesh	0.90 to 1.0	4.35
— 6 mesh + 8 mesh	1.31 to 1.0	4.41
— 8 mesh + 10 mesh	1.90 to 1.0	5.63
—10 mesh + 20 mesh	3.30 to 1.0	....

Of course, any particular size would include chats containing almost no zinc, while chats of the same size would contain probably more than twice the average amount of zinc. But the point at issue is the respective zinc tenor of the various sizes of average chats and not the tenor of a particular chat grain of any or all sizes.

In the last column of Table I, it is shown that as the average chat grain decreases in size, its zinc tenor increases; the —¼ + 7/16-in. chat product contains 4.01 per cent zinc, and the zinc content steadily increases until the —8 + 10 mesh size contains 5.63 per cent zinc. A similar increase in the zinc content with decreasing size appears in the last column of Table II, where the —⅛ in. + 8 mesh size contains 4.30 per cent of zinc and the —10 + 14 mesh size contains 8.25 per cent zinc.

Table II—Chats Crushed to Pass ⅛ in. to Show Progressive Enrichment of the Chat Grains With Decreasing Size

Product Size	Ratio of Free Flint to Chats	Per Cent Zinc of Average Chat Grain
— ⅛ in. + 8 mesh	1.54 to 1.0	4.30
— 8 mesh + 10 mesh	2.63 to 1.0	6.87
—10 mesh + 14 mesh	2.57 to 1.0	8.25
—14 mesh + 20 mesh	4.31 to 1.0	....

In these two tables every size of chats, including the coarsest, is richer in zinc than the original chats (about 7/16 in.) which were crushed. (Chat product before crushing contained 2.90 per cent zinc.) In all probability the reason for this is that all the chats crushed were at least 7/16 in. in size and all were crushed through at least ½ in. in Table I. Had these 7/16-in. chats been crushed through just 7/16 in., then probably the first size of the crushed product, say 7/16 in. + ⅜ in., would have contained chats leaner than or having about the same zinc tenor as the original chats (2.90 per cent zinc). Again, if these 7/16-in. chats had been crushed through 20 mesh, the first size of the crushed product, say —20 + 28 mesh, would contain chats much richer than the original chats, and the chats in this case would contain probably 10 per cent zinc or more.

Elimination of Free Flint

An important feature to note in the results in Tables I and II is that free flint was liberated in the grinding of these 7/16-in. chats. The original product, before grinding, contained no free flint, yet the first line of column 2 of Table I indicates that free flint and chats are present in the proportion of ⅜ to 1. With decreasing size the ratio of free flint to chats increases rapidly, until in —10 + 20 mesh size there is 3.3 times as much free flint as chats; in other words, this particular size contains 76.8 per cent free flint and 23.2 per cent chats. This rapid increase in the ratio of free flint to chats is also apparent in column 2 of Table II and here it is even more marked, as the sample had been crushed to pass ⅛ in. For instance, in the —8 + 10 mesh size of Table I, the ratio of free flint to chats is 1.90 to 1, whereas in the same size in Table II, the ratio is 2.63 to 1. Hand-sorting was not carried below 20 mesh in these two experiments, because the material at that size is so fine that work becomes both tedious and inaccurate; a microscope would have to be used for good work on this fine material.

The effect of crushing the above samples of chats is further shown in Table III, which gives more information as to the progressive enrichment of chats. Table III presents the zinc content of the various screen sizes of the two lots of chats crushed through ¼ and ⅛ in.

Table III—Zinc Content of Sized Products After Crushing Through ¼ in. and ⅛ in.

Product Size	Per Cent Zinc Through ¼-In.	Through ⅛-In
— ¼ + 7/16 in.	2.44	....
—7/16 + ⅜ in.	2.29	....
— ⅜ + 8 mesh	1.91	1.69
— 8 mesh + 10 mesh	1.96	1.89
—10 mesh + 14 mesh	2.29*	2.31
—14 mesh + 20 mesh	2.62	1.99*
—20 mesh + 28 mesh	3.37	2.57
—28 mesh + 35 mesh	4.78	3.30
—35 mesh + 48 mesh	5.68	4.05
Minus 48 mesh	9.56	7.04
Composite	2.90	2.90

The analyses record the zinc tenor of the products prior to hand-sorting. In the first five sizes recorded in Table III (which are the particular sizes studied in Table I) under the heading "Through ¼ in." the zinc content shows little variation, yet Table I indicates that in the first size, —¼ + 7/16 in., the free flint comprised about 39 per cent of the sample, whereas in the fifth size, —10 +20 mesh, the free flint was 76.8 per cent, or practically twice the amount in the first size. This fact alone, obtained from a screen analysis and hand-sorting for free flint in the various sizes, would have indicated that the chats must be richer in the finer sizes than in the coarser sizes. Stated differently, the zinc tenor of the first five sizes in Table III is nearly the same, but the relative amounts of chats have decreased greatly in the finer sizes; therefore the chats must be richer in order to contain the same amount of mineral as the chats in the coarser sizes. The same phenomenon is observed in the column under "Through ⅛ in."

The progressive enrichment of chats may be compared to the increasing richness of the finer sizes of any mill feed in the district; so does the ratio of free flint to chats increase with decreasing size of mill feed.

The stars (**) in Table III mark the first appearance of free blende. The liberation of blende in the fines progressed to a remarkable degree; grinding to ¼ in. completely liberated 40 per cent of the mineral, and grinding to ⅛ in. liberated 53 per cent of the mineral. The liberation of such large amounts of free mineral is almost astonishing when it is remembered that the chats ground were of very low grade (2.90 per cent zinc) and that rich grains were absent.

Laboratory work is sometimes shadowed by a fear that laboratory results will not be maintained in practice. To obviate this possibility the investigation was transferred to the mills, and it was found that the progressive enrichment of chat grains with decreasing size occurred in every case examined. Many different products were studied and sufficient evidence was obtained

to prove the proposition. In no instance have we found any contrary evidence.

A rougher jig was sampled. This jig was doing what is commonly called "drawing heavy on the last chatter" to obtain a product to be reground and fed to a secondary rougher jig. In other words, this product was being taken from the side of the jig at the bottom of the tailboard, while the tailing which was sampled was going over the top of the tailboard. This material from the last draw and the concurrent tailing were both sized and some of the coarser sizes of each were hand-sorted for chats and free flint. The hand-sorted chats were analyzed for zinc. The results are shown in Table IV.

Table IV—Progressive Enrichment of Chat Grains in a Chat Draw and in the Tailing Taken From a Rougher Jig

	Last Chat Draw		Rougher Jig Tailing	
Product Size	Ratio of Free Flint to Chats	Per Cent Zinc in Average Chat Grain	Ratio of Free Flint to Chats	Per Cent Zinc in Average Chat Grain
—½ in. + ⅜ in.	2.38 to 1.0	8.62	4.21 to 1.0	4.08
—⅜ in. + ¼ in.	3.71 to 1.0	14.16	6.00 to 1.0	7.36

Here again is noted the progressive enrichment of chats with decreasing size both in the product from the last chat draw and in the rougher jig tailing. The enrichment of chats in the last chat draw product is from 8.62 to 14.16 per cent zinc for a corresponding decrease in size from ½ to ¼ in., whereas in the rougher jig tailing the enrichment, though less, is from 4.08 to 7.36 per cent zinc for the same decrease in size. The increase in the ratio of free flint to chats with decreasing size occurs in these two products. The ratio is greater in case of the tailing, because the action of the jig is an effort to eliminate free flint and settle the heavier particles of chats. The chat grains escaping into the tailing are leaner than those caught by the chat draw; however, this last statement does not prove that the chats in the tailings of the district are valueless to the operator.

The investigation was continued by sampling a rougher jig tailing at another mill. The sample was sized and some of the coarser sizes were individually jigged on a laboratory jig. A chat concentrate and a low tailing called a "laboratory jig tailing" were made from each size of material jigged. If any free flint entered the chat concentrate in the laboratory jigging it was removed by hand-sorting and added to the tailing; thus the zinc tenor of the chat concentrate shown in Table V was that of a chat product with both free flint and free mineral removed. The zinc tenor of each of the products formed by sizing and laboratory jigging is shown in Table V.

Table V—Progressive Enrichment of Chat Grains in a Rougher Jig Tailing

	Per Cent Zinc		
Product Size	Rougher Jig Tailing	Laboratory Jig Tailing	Chat Concentrate
—7/16 in. + ⅜ in.	0.98	....	12.00
—⅜ in. + 5/16 in.	1.40	1.08	18.43
—5/16 in. + ¼ in.	1.40	0.82	19.66
—¼ in. + 3/16 in.	1.52	1.03	23.45
—3/16 in. + ⅛ in.	1.57	0.87	23.53
—⅛ in. + 2 mm.	1.67	0.67	32.20

The first column shows the various sizes which were screened out of the rougher jig tailing and jigged on the laboratory jig. The second column shows the composite zinc tenor of each size before laboratory jigging and the third column gives the composite of the tailing made by the laboratory jig. The grades of the chats taken out of each size by the laboratory jig appear in the last column. The zinc tenor of the average grains in the chat concentrates increases steadily from 12 per cent for the coarsest zinc (—7/16 + ⅜ in.) to 32.2 per cent for the finest size shown (—⅛ in. + 2 mm.); thus, progressive enrichment of chats with decreasing size again appears.

The grade of this particular rougher jig tailing was possibly lower than the average for the present milling practice, yet it should be observed that some very rich chats escaped into this tailing. If chats as rich as those indicated in the last column of Table V could be isolated from the rougher jig tailing it would certainly pay to regrind this tailing for recovery of the contained mineral.

Investigations on Mill Feed

The investigation was next carried to the head of the mill. Ten mills were selected at random and samples of the mill feed were taken under the primary (dirt) rolls. A small part of each sample was quite coarse and had to be cracked by hand, so that all of each sample passed through a ¾-in. ring. Each sample was screened into a number of sizes. Each size was hand-sorted; the chats were analyzed for zinc and the ratio of free flint to chats was calculated. All of the ten mill feeds sampled showed the same characteristics, so for brevity the tabulation for one of them is selected as representing all the samples. It is shown in Table VI.

Table VI—Progressive Enrichment of Chat Grains in Mill Feed

Product Size	Ratio of Free Flint to Chats	Per Cent Zinc of Average Chat Grains
—¾ + ½ in.	2.09 to 1.0	13.30
—½ + 7/16 in.	2.87 to 1.0	18.30
—7/16 + ⅜ in.	3.65 to 1.0	20.80
—⅜ + ¼ in.	5.00 to 1.0	27.10

This table discloses the fact that the phenomenon under consideration—progressive enrichment of chats with decreasing size—occurs in the mill feed. Then it would logically follow that the same phenomenon must occur in every mill product. That such is the case is shown by the evidence already presented.

The evidence of enrichment is conclusive. If the operators will discard the old theory, "once a chat always a chat," and will accept the facts presented herein, an advance will be made toward increasing revenue. The fact that the average fine chat is richer than the average coarser chat in the same product is the reason for the degree of success now enjoyed by the present process; if the reverse were true—that is, if the average fine chat were leaner than the average coarse chat—the former could not be recovered at all on the rougher jig.

Commercial Applications of the Work

One possible commercial application of the principles of progressive enrichment of chat grains may be mentioned, as it will call attention to something that has been overlooked. Reference is made to Table V, where the zinc tenor of the various sizes of a rougher jig tailing is shown in the second column The zinc contents for the various sizes run about the same, the coarsest size (—7/16 + ⅜ in.) excepted. Provided the composite tailing is sufficiently low, no further thought is given to this question. Yet a glance at Table V will show that the coarsest part of the tailing (—7/16 + 5/16 in.) is capable of making a chat concentrate with a zinc tenor of only 16 per cent, whereas the finer part (—⅛ in. + 2 mm.) would yield a product of chat grains nearly twice as high in zinc. This ratio of grades would hold in practice, but the absolute values would depend upon the particular circumstances. Many rougher jig tailings contain chats which are rich enough to warrant their re-

covery; chats ranging around ¼ in. to 2 mm. in size in particular are generally of very good grade.

The attempt to make a finished tailing by one pass over the rougher jig often fails. The zinc tenor of the chat concentrates in the last column of Table V clearly indicates that the rougher jig would extract all the recoverable zinc if the ore passed over it but once. Sizing followed by a subsequent treatment of all or of a part of the tailing would yield a revenue by recovering many of these rich chats. At least a certain amount of sizing is necessary in order that thorough recovery of chats may be effected, but the way in which this might be done is not discussed here, because it has been cited in the first part of this paper.

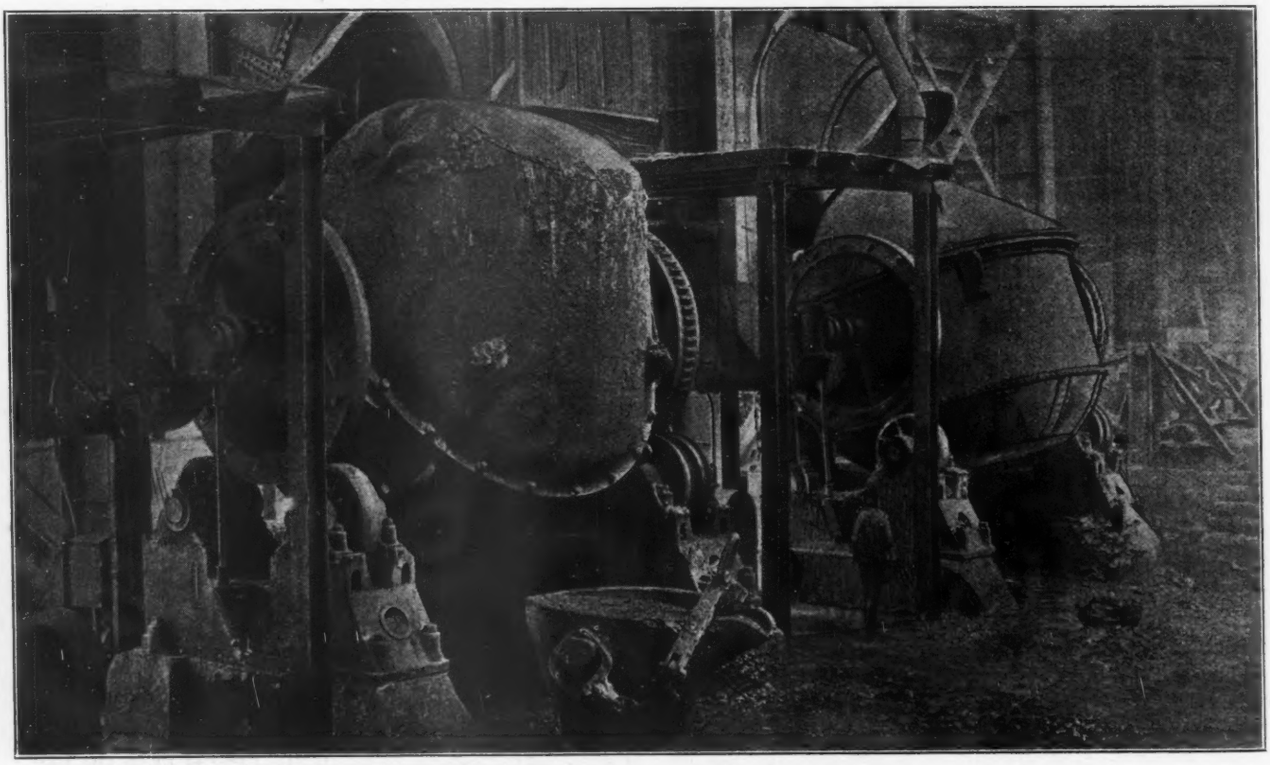
A certain operator who was keenly conscious of the commercial aspect of mining and milling made a statement that should be broadcast to the mining public: "When we get the ore into the hopper, we have it paid for and must mill it so that we can get our money back." This statement, though a slight exaggeration, implies the well-known fact that the milling cost is but a small part of the total cost of operation.

In addition to the commercial phase, there is an academic phase to this problem of progressive enrichment of chats, but we have not yet had time to pursue investigation beyond the point where the commercial tinge is strong. There would be academic interest as regards the mechanics of grinding and the cementation of chat grains. Furthermore, the fact of progressive enrichment of chats might well apply to ores of other districts to indicate the fineness to which chats should be ground to yield a chat product sufficiently rich for other milling operations or for the market.

Apropos of the data given on progressive enrichment of chat grains, a few remarks may be of interest. Although the tone of the paper indicates that one sample of chat grains was ground to ¼ in. and another to ⅛ in., that two products were taken at the end of a rougher jig, that a rougher jig tailing was studied, and that ten samples were taken of the feed of as many mills—all for the express purpose of proving or disproving the theory of chat enrichment—the fact is that this evidence was gained from the above-mentioned samples when they were being studied for entirely different purposes. Many other samples besides those mentioned have revealed this characteristic of progressive enrichment of chats. So the data presented herewith had only to be culled from notes already compiled. When an investigation is pursued to prove or disprove a particular supposition the personal equation often enters, but in this case it was absent. When an opportunity is given to pursue research unhampered by outside influence, the resulting notes, like antiques, have an increasing value with age. Unfortunately for the profession, too many metallurgists are obliged to rush through their tests, and after gleaning some point of immediate value leave the notes unfinished, so that further interpretations cannot be made after the details have been forgotten.

In conclusion, we believe that the evidence presented proves the progressive enrichment of zinc chats with decreasing size. Whether this is true of ores other than those of the Tri-State district we do not know, but we hazard the guess that this principle might serve as a good working basis for investigating ores of other districts.

After all is said and done, the problem of grinding ores becomes in the last analysis a study in grinding locked minerals (chats); if there were no locked minerals, there would be no necessity of grinding.



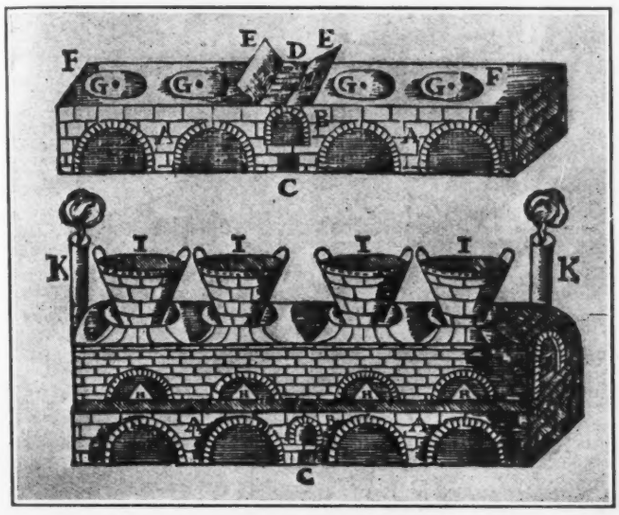
Great Falls Type Copper Converters

Mining from 1550 to 1700

The Philosopher's Stone and the Elixir of Life—Quaint Conceptions of the Nature of Minerals and Metals—Influence of the Alchemists on Mining and Metallurgy

By H. H. Manchester

OUTSIDE of the practical descriptions of Agricola, the most interesting facts in the advance of metallurgy during 1550 to 1700, the period herein covered, are to be found in the works of the alchemists. Unfortunately they are often buried under such a mountain of mysticism or secreted with such laborious pains from the vulgar understanding as to be almost undiscoverable. As a matter of fact, the al-



Barba's furnace for pan-amalgamation; the process discovered in 1609

chemists were probably wrong in nine statements out of ten, but experience gradually wore away the false ideas, and the true ones developed into chemistry, metallurgy and medicine.

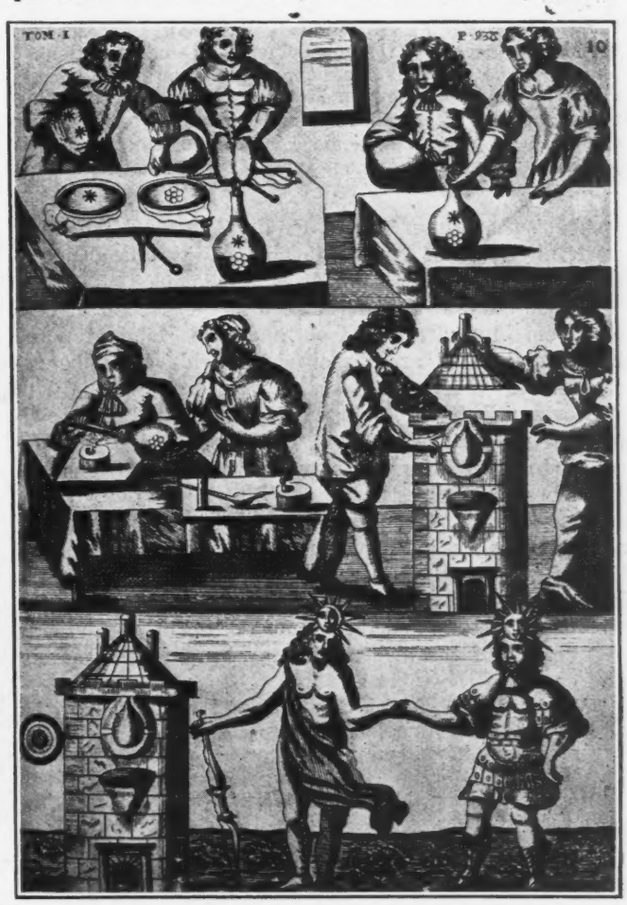
In ancient times it was thought there were four elements—air, earth, fire, and water. The alchemists broke down this error, but went to the other extreme, and thought that all things were to be derived from one element. This led to the belief in the transformation of metals, and to innumerable fruitless efforts to turn baser metals into gold. It was thought this could be done through the fabled philosopher's stone, and many quacks, in fact, claimed to have done it. Nevertheless, search for the impossible did lead the alchemists to discover how to break up various substances, among which were several metallic compounds. Thus, as far back as the thirteenth century, Albertus Magnus wrote that a certain fluid now known as nitric acid could be used to dissolve silver and thus separate electrum into gold and silver. This method was also used by Paracelsus in the first half of the sixteenth century. He wrote that the gold would settle like sand, and that the dissolved silver might be recovered by placing a copper plate in it.

Paracelsus, however, turned the object of alchemy from the pursuit of gold to that of eternal youth—from the philosopher's stone to the elixir of life. This led to a search for essences and chemical medicines. Paracelsus himself considered alum a combination of an earth and an acid, and knew how to obtain zinc and bismuth. A pupil of his, Thurneysser, started mining and extracting sulphur at Tarenz about 1558, and later became a court physician at Brandenburg. The manufacture of white lead was carried on by Pantheus before 1560. Hieronymous Cardanus, 1501-1578, of Pavia, who was a noted physician as well as alchemist, remarked the increase in weight in the calcination of lead.

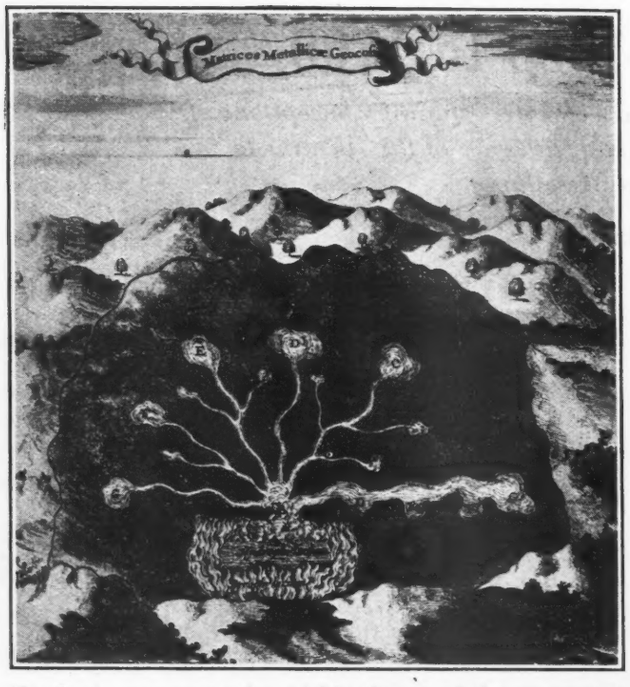
An opponent of Paracelsus was Dr. Andreas Libavius, 1540-1616, who, though he did not believe in the elixir of life, nevertheless kept up the search for chemical medicines. He noted that the fumes of sulphur blackened white lead, and he purified cinnabar by means of arsenic and lead oxide.

A discoverer in metallurgy who was not an alchemist was Alvaro Alonso Barba, 1575-1650. He was born in Andalusia, Spain, but later became a priest at Potosí. Here in 1609 he discovered the pan-amalgamation process. His account of the discovery runs as follows:

"Wishing to try an experiment on a method of fixing quicksilver in an iron vessel, of which I had read, and not



An alchemist representation of metallurgical processes



Kircher's representation of his theory of the generation of metallic veins

having such a vessel, I used one of copper. But not succeeding in the operation, I added finely-ground silver ore to the quicksilver, with the notion that the mineral virture of this stone might, by the heat and moisture of the cooking, further my object. In a short time I extracted a large quantity of silver amalgam and silver, which at first much surprised me; but my astonishment ceased when I found that the silver collected by the quicksilver had come from the ore and not from quicksilver transmuted. I was highly satisfied with this, my new and short method of extracting metals, which, after reflection and constant experimenting during many years, I have since improved. I have made it publicly known, and have not kept either it or other secrets to myself."

About that time Oswald Croll, 1580-1609, who was court physician of Anhalt Bernburg, introduced potassium sulphate, silver chloride, and calomel.

Angelo Sala, 1575-1640, described the deposit of copper from blue vitrol on iron, and Van Helmont noted how metals that are dissolved in acids could be recovered.

Giovanni Battista Porta, of Naples, applied his knowledge of metallurgy to glass making with distinct success. In 1623 he wrote a work which was translated into English under the title "Natural Magick." The section in this "On Changing Metals" occupies about seventeen pages, and gives a wonderfully good conception of the mingled mysticism, false ideas, and truths in the alchemist metallurgy of the period. It is far too long to be quoted, but some notion of the objects and beliefs of the alchemists may be gathered merely from some of the subtitles:

"Which treateth of Alchemy; shewing how Metals may be altered and transformed, one into another.

"Of Tin, and how it may be converted into a more excellent Mettal.

"How to remedy the softness of Tin, and the creaking noise that it makes.

"How to bring Tin into Powder.

"How to alter and transform Tin, that it may become Silver.

"Tin into Lead.

"Of Lead, and how it may be converted into another Metal.

"To change Lead into Tin.

"Antimony into Lead.

"How to Procure Lead to become heavier than of itself it is.

"To extract Quicksilver out of Lead.

"Lead converted into Quicksilver.

"Of Brass; and how to transform it into a worthier Mettal.

"Brass to counterfeit Silver.

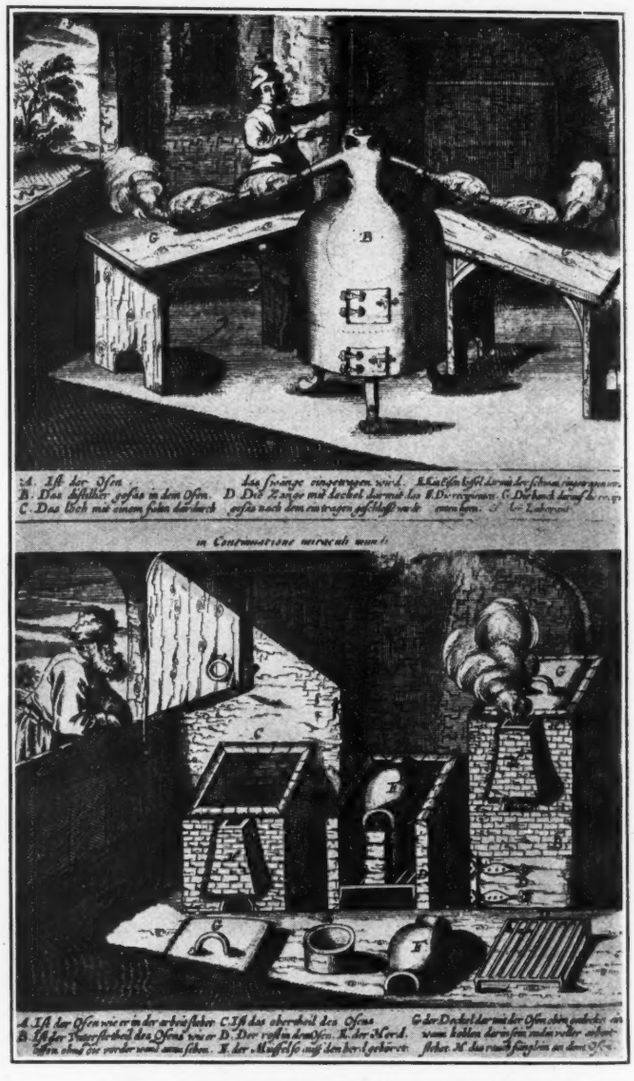
"To make brass shew itself of a silver colour, by rubbing it betwixt your hands.

"Of Iron, and how to transform it into a more worthy metal.

"Change Iron into Brass.

"Make Iron to become white.

"How Quicksilver may be congealed and curdled as it were with Iron.



Two furnaces illustrated by Glauber

"Congealing of Quicksilver with balls of Brass.

"To draw water out of Quicksilver.

"To make Quicksilver grow to be a Tree.

"Of Silver.

"To give Silver a Gold colour.

"To tincture Silver into Gold.

"Fix Cinnaber.

"From fixed Cinnaber to draw out a silver beard.

"To draw forth the life of Tin.

"How to make a Metal more weighty."

One of the accomplishments of the alchemists was to make one metal so closely resemble another that under ordinary tests it would pass for it. This was really the basis of the idea that they could transmute metals. The following, for example, was Porta's recipe:

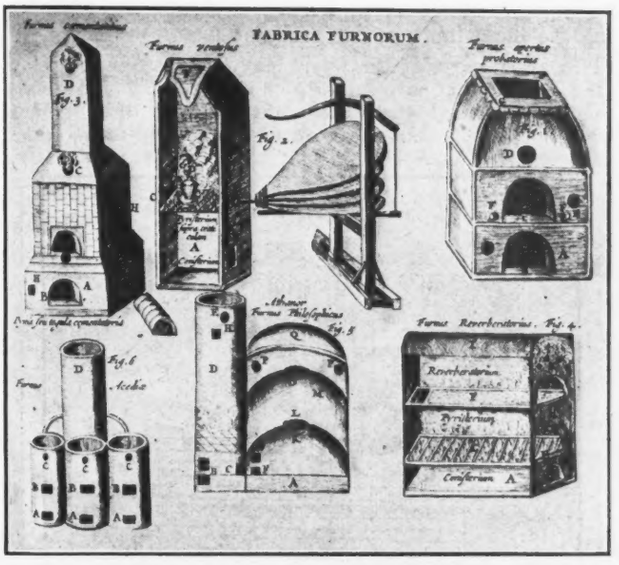
"To tincture Silver into Gold.

"If I mingle the congealed quicksilver that I speak of with a cap, with a third part of silver, you shall find the silver to be of a golden colour: you shall melt this with the same quantity of gold, and put it into a pot: pour on it very sharp vinegar and let it boil a quarter of a day, and the colour will be augmented. Put this to the utmost trial of gold, that is, with common salt, and powder of bricks, yet adding Vitriol, and so shall you have refined gold."

Possibly many of the alchemists even fooled themselves into thinking that they could manufacture pure gold. Apparently Porta thought so, and lest the reader think I am holding back the great secret, I will give his recipe for making gold from silver:

"The way is this: Put the fine filings of Iron into a Crucible that will endure fire, till it grow red hot, and melt: then take artificial Chrysocolla, such as Goldsmiths use to soder with, and red Arsenic, and by degrees strew them in: when you have done this, cast in an equal part of Silver, and let it be exquisitely purged by a strong vessel made of Ashes: all the dregs of the Gold being now removed, cast it into water of separation, and the gold will fall to the bottom of the vessel, take it: there is nothing of many things that I have found more true, more gainful or, more hard: spare no labour, and do it as you should, lest you lose your labour."

An opponent of the alchemists was Athanasius Kircher, 1602-1680. He was a Jesuit priest and professor at Avignon. He made no important discoveries of his own in metallurgy, but his massive tomes form an encyclopedia of the knowledge of the period. Among

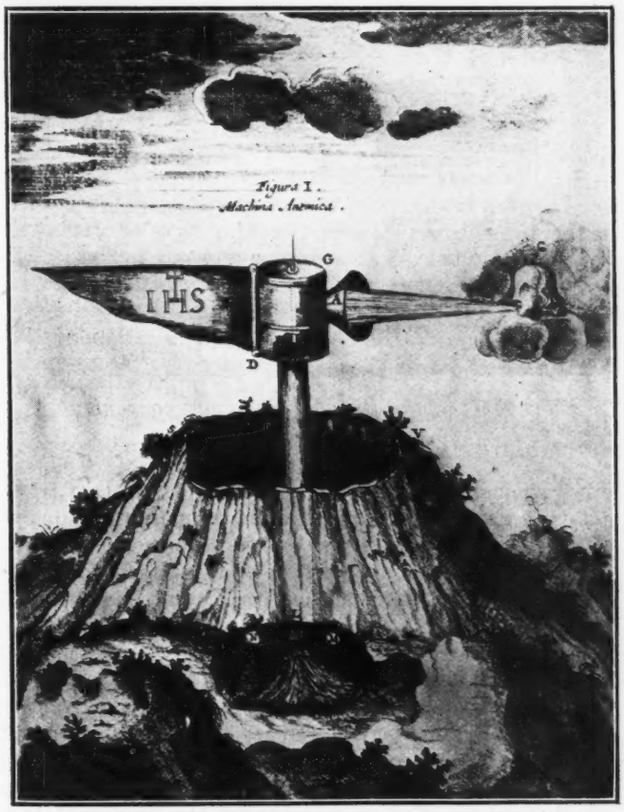


Various types of furnaces used in metallurgy (Kircher)

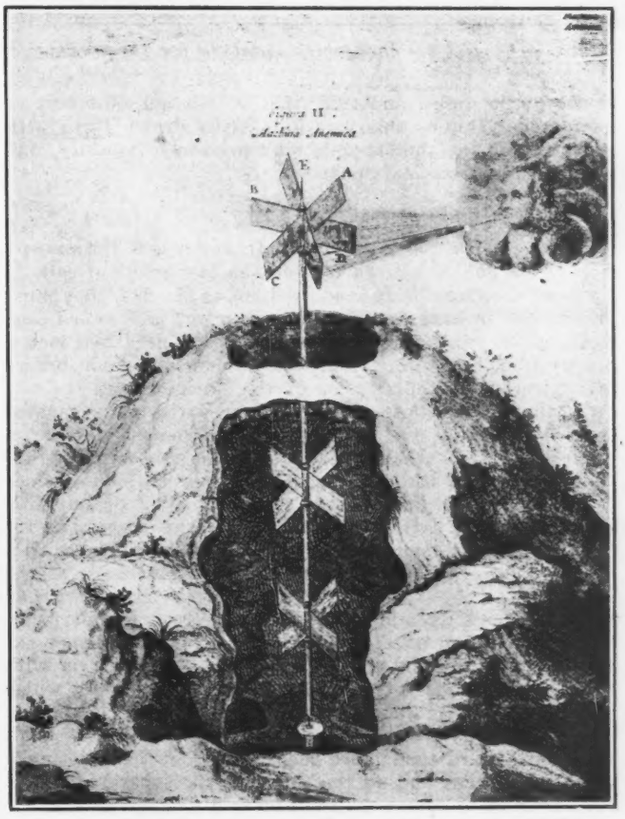
their engravings are interesting ones showing the ventilation of mines, and various types of metallurgical furnaces.

One of the best-known seventeenth century alchemists was John Rudolph Glauber, 1604-1668. He introduced sodium sulphate, which was named after him, and hydrochloric acid, as well as a method of obtaining gold from clay and flint, by what he called spirit of salt, or hydrochloric acid. He also seems to have been the first to use leaden vessels for containing acid vapors.

Two of his passages on the extraction of gold from



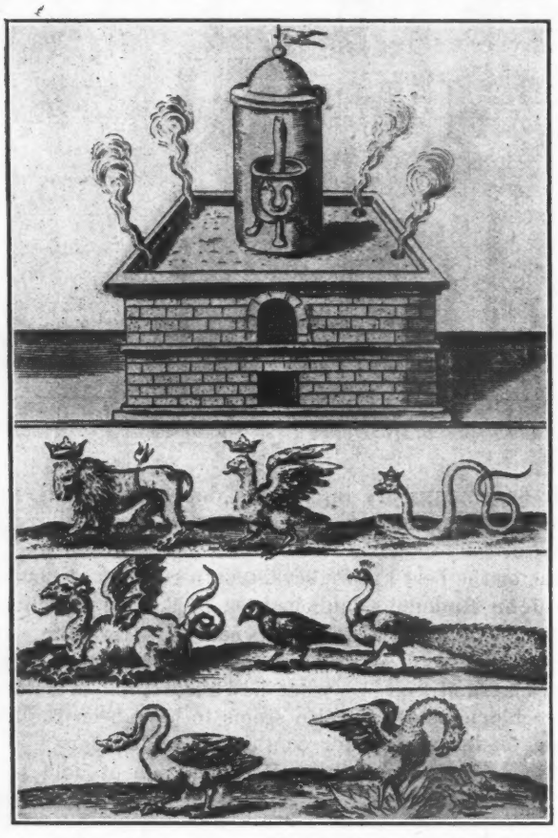
A method of ventilating a mine (from Kircher)



Another method of ventilating a mine (from Kircher)

clay may be of interest. First is a statement emphasizing the importance of the process:

"In every parte of the world may be found potters clay, sand or flints that have subtile gold in them. . . There are sometimes found whole mountains full of those stones, which have such a spirituall or subtile gold in them, which



An alchemist furnace, with symbols for the metals

is so subtile, light, and thin, that it will not quit cost to melt them. But by this way it is easily drawn forth with spirit of salt, so that anyone may privately, honestly, and plentifully get his maintenance."

Now for the process itself:

"Here follows the preparation of flints, and the extraction of the gold contained in them, by the spirits of salt.

"First the flints being made red hot in the fire, they must be quencht in cold water, after taken out and cooled, and finely powdered. . . But sand and clay need not such a preparation, but without a preparation being made before are extracted by the affusion of the spirit of salt.

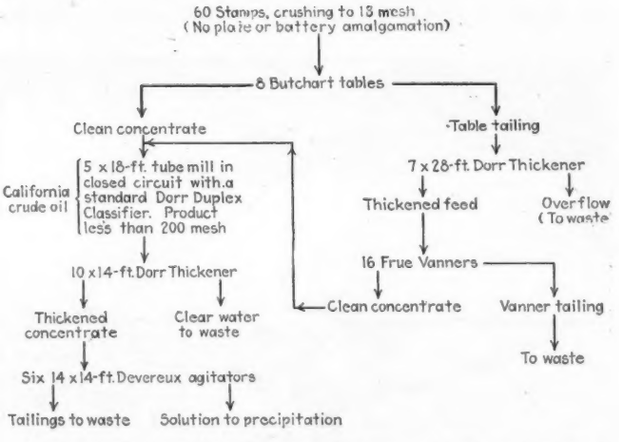
"R. then of the flints as aforesaid prepared and separated two, three, four, six pound, to which being put into a cucurbit of glass whole (undivided) pour the spirit of Salt to the depth of three or four fingers breadth, and place it in hot sand or *Balneo*, that there the spirit of salt may be hot, and may extract the Gold, and so let it continue for five, six or more hours space, until the spirit tinged with a deep redness, can extract no more. And perchance at the first time (though seldom) it may not be tinged with so great a redness, then must you decant that same imperfectly tinged spirit, and pour to other flints after the manner expressed, prepared in another cucurbit, and place it with the flints in a moderate heat for to extract the gold; which done pour it off again, and pour it to fresh flints, and do so often until it hath drawn to it a sufficient quantity of gold; which afterward thou must keep, until thou hast gotten a greater quantity, and all the Gold may be separated at one time from it, as afterward shall be said.

"Which done pour to the reserved flints in the first cucurbit, a fresh spirit of salt, and leave that so long in heat until it be coloured, and extract the gold that is left in the flints, and was not at the first time extracted; which spirits being afterward decanted, pour it to the flints reserved in the second and third cucurbit, to extract the residue of the gold which was left at the first time, and so consequently to the others reserved, until the spirit be sufficiently coloured, and can attract no more; which afterward pour off and put it to the first, which was reserved. You must also pour a fresh spirit to the remainder of the extraction for the extracting of all the gold. At length pour to it also common water to wash away the tinged spirit of gold remaining in the flints, that none of the Gold may be lost."

Fuel Oil Aids Cyaniding at the Belmont Shawmut

The Belmont Shawmut mine, on the Mother Lode in Tuolumne County, Calif., produces a sulphide ore, consisting largely of pyrite, with free gold subordinate. The gangue is characterized by dolomite and to a less extent by lime.

Numerous methods of metallurgical treatment have been tried, according to a report of the State Mineralogist. Originally there was the regulation stamp milling with plate amalgamation. Then a chlorination plant was installed and used until the Belmont Mining Co. bought the mine. The Belmont installed Jones Belmont flotation cells and made two grades of concentrates, one on the tables and the other with the flotation cells. These concentrates were shipped at first, but their low grade and the cost of shipment and treatment led to experimenting. In these experiments, it was found that for some reason the oil-floated concentrate responded better to cyanide treatment than the straight table concentrate. It was assumed that the oil used


60 Stamps, crushing to 13 mesh
(No plate or battery amalgamation)
8 Butchart tables
Clean concentrate
Table tailing
California crude oil
5 x 18-ft. tube mill in closed circuit with a standard Dorr Duplex Classifier. Product less than 200 mesh
7 x 28-ft. Dorr Thickener
Thickened feed
Overflow (To waste)
10 x 14-ft. Dorr Thickener
16 Frue Vanners
Thickened concentrate
Clear water to waste
Clean concentrate
Vanner tailing
To waste
Six 14 x 14-ft. Devereux agitators
Tailings to waste
Solution to precipitation

Flow sheet of the Belmont Shawmut concentrator and cyanide plant

was responsible for this. It was also found that while flotation gave satisfactory results from the standpoint of recovery, it was more expensive than the results justified. Flotation has therefore been laid aside at present and the flow sheet outlined in the cut has been put in effect. O. McCreaney, general superintendent, says that it is giving good results.

Under the method now used, eight to ten pounds of California crude oil are added for each ton of concentrate when regrinding preliminary to cyanide treatment. This gives the hydrocarbon content which is assumed to promote recovery. The tables and vanners alone are relied upon to effect a recovery of the free gold that is present.

The Filling of Fissure Veins

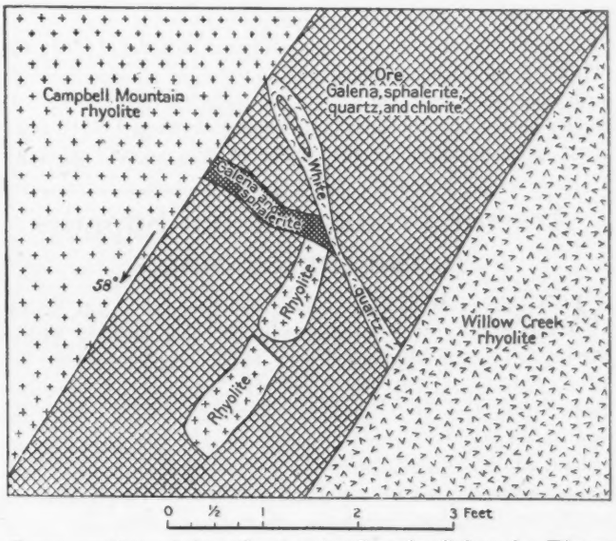
By J. E. Spurr

IT HAS ALWAYS BEEN HELD that most fissure veins were filled by deposition from waters, either hot or cold. It has been held that such waters—those which we denominate hot-spring waters, for example—held in solution relatively small quantities of metals, which were gradually precipitated, along with quartz and other gangues, until the fissure was filled. In my book on "The Ore Magmas" I have examined into the evidence for this belief and have failed to find the needed proof that this hypothesis—for on examination it turns out to be a simple hypothesis—is a true one. On the contrary, I do find, and present, a great deal of evidence tending to show that many fissure veins have been suddenly filled by injection of a heavy and highly concentrated solution containing metals and non-metals; that this injection, penetrating along a rift in the rock, has distended it, producing in this way the "fissure" of the fissure vein, and has subsequently crystallized or frozen to form the vein material, excluding on crystallization the water and other fluid and volatile material which escapes the consolidation.

One of the lines of evidence of this origin lies in the angular inclusions of wall rocks, or of earlier-crystallized vein material, which are frequently observed, isolated in the vein material. These could not have floated thus, detached, between the walls of an open fissure; and I believe that the only admissible explanation is that they were floated and supported in the heavy ore solution, which (being, as I have shown, a phase of igneous activity, and an extreme product of differentiation from a molten rock-magma intrusion or surgence) I have called the ore magma. I have illustrated this occurrence of floating inclusions by drawings made by myself and others.

I have been looking over the excellent Bulletin 718, of the U. S. Geological Survey, just received. This is the "Geology and Ore Deposits of the Creede District, Colorado," by W. H. Emmons and Esper S. Larsen. When one has learned to recognize a new flower, in the summer, he is surprised to find all roadsides lined with it, although he does not recall ever having seen it before. So now the floating inclusions in fissure veins peep out to me from many books which I pick up. In the bulletin in question they are shown in drawings which I am reproducing here. They are figures 7 and 8 of the Bulletin, showing the Amethyst and the Overholt veins respectively.

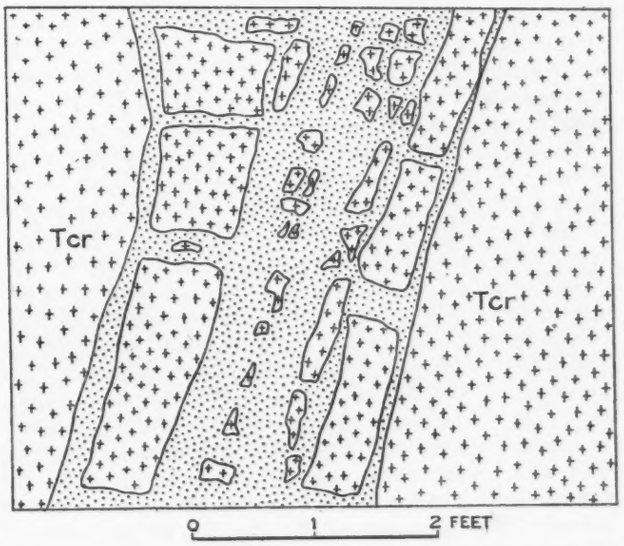
Note the inclusions of rhyolite in both figures. Now, what do the authors say about the origin of these fissure veins? "It is believed" they say, "that the major part of the deposits were formed in open spaces." If, then, the veins were the filling of open spaces (and I accept the statement as correct), how did the inclusions of rhyolite maintain themselves in the open spaces during the precipitation of the vein material? An alternative explanation (assuming that the authors were wrong as to open spaces) would be that the veins have formed by replacement, and that the so-called inclusions are residues from this replacement. But the authors have considered this and rejected it. Of both figures 7 and 8 they say, "The fragments of rhyolite are angular. The solutions which cemented these materials apparently had little power to dissolve the rhyolite, for the edges of the blocks are sharp." The illustrations show this also. The elimination of this explanation forces us back to the conclusion of the suspension of the blocks, isolated, in the ore solution, and the further conclusion that the solution must have been heavy and dense, not waters, but what I have designated as



Cross-section of Amethyst vein, Creede, Colorado, Figure 7, Bulletin 718, U. S. Geological Survey

ore magmas. The only possible mechanics of which I can conceive for the formation of veins like this is the injection or intrusion of a heavy ore magma, forced along a rift, distending it into a fissure, and thereafter consolidating or freezing.

Geological opinion has for some time been restless on this subject of vein filling, and one hypothesis sub-



Cross-section of Overholt vein, Creede, Colorado. Figure 8, Bulletin 718, U. S. Geological Survey. Tcr, rhyolite; stippled areas, barite and sulphides

mitted has been that of the forcing apart of the fissure walls by the force of crystallization. But in the cases illustrated here the vein filling appears to be massive, not banded; and the formation, by the force of crystallization, of fissure veins two or three feet wide, appears to be excluded by general considerations. Never-

theless, the exponents of this view might be inclined to consider it for Fig. 8; but in Fig. 7 it will be noted that the included rhyolite fragments cannot be regarded as split off from the wall rock shown in the figure, for the walls are smooth and show no break. Therefore, these fragments in Fig. 7 have been brought into the section sketched, from outside points—borne in by the invading ore magma.

Finally, these figures show two additional features which I have described in other veins, in my book on ore magmas, and found to be usual and typical. In both figures the included blocks are arranged with their long axes parallel to the walls of the veins, showing, I think, that the predominant pressure at the time of the consolidation of the ore magma was the pressure in from the walls, and not the pressure of gravity. Another point is that in Fig. 7 the inclusions are of the rhyolite from the hanging wall of the vein—not the footwall. I have described a similar occurrence in other veins ("The Ore Magmas," Fig. 22), together with other phenomena (Fig. 21) which altogether indicate a frequent tendency of inclusions to settle in the fluid ore magma, but not great enough to result in sinking. So that while the dominant pressure, as above stated, is registered as being from the walls, the gravity pull is indicated as being present, though subordinate.

Arsenic Production and Supplies in the United States

WHITE ARSENIC was produced at nine plants operated by six companies in the United States during the first six months of 1923. According to the U. S. Geological Survey, the sales during the first five months of the year and the estimated sales in June amounted to 6,035 short tons of refined arsenious oxide, valued at 8.36 to 15c. a pound, and 1,183 tons of crude oxide, valued at 7.46 to 10c. a pound. Besides these products, calcium arsenate was made directly from ore at Salt Lake City, Utah.

These figures show a lower average rate of production than that of last March, when the activities of the principal producers indicated a considerable increase rather than a decrease in the rate. No large stocks of white arsenic remained at the works, and the prospect is good that production during the last half of the year will equal or exceed that during the first half. The rate of production maintained implies an increase of 25 per cent or more over the output in 1922, but is much less than the possible output stated last April, when proposed increases indicated a domestic production of 22,000 tons. In the United States all white-arsenic plants provide for relatively high rates of production prior to the hot season and after its close, but during that season operations are curtailed.

The imports of white arsenic during the first three months of 1923 amounted to 2,694 short tons, valued at $447,645. During this period Germany shipped the largest quantity—588 short tons—and was followed by Japan, with 513 tons, valued at $78,869.

The Western States have the largest undeveloped deposits of arsenic, and these are now receiving attention. Several new plants for the direct treatment of arsenic ores are planned. New sources of arsenic are necessary if the United States is to continue to supply the bulk of its requirements. At present the arsenic produced is largely a byproduct obtained in smelting lead and copper ores, and the ores charged into the furnaces contain an average of less than 1 per cent of arsenic. The deposits of Montana at present furnish the largest supply of arsenic. Enargite, the arsenical copper mineral in the ores mined at Butte, Mont., yields most of the 3,000 tons of white arsenic recovered annually at the Anaconda refinery. Since March, 1923, white arsenic more than 99 per cent pure has been produced at Jardine, Mont., at the rate of about 100 tons a month. With the addition of the arsenical speiss and flue dust produced at the East Helena lead smelter and shipped to Tacoma, Wash., and Globe, Colo., Montana leads the United States in its output of white arsenic, producing more than 4,500 tons annually.

Nevada has the largest available supply of arsenic above ground in the United States. At Eureka there is a great accumulation of speiss from smelting operations that were carried on in the seventies. During the first six months of 1923 this speiss dump was drawn on by the smelters in Utah and Washington at the rate of 2,000 tons a month. The speiss carries an average of 30 per cent of arsenic, and when all metallurgical losses are deducted it probably provides 3,500 tons of white arsenic annually. At Toulon, near Lovelock, Nev., the Toulon Arsenic Co. operates the only arsenic plant in Nevada. This plant roasts custom ore containing arsenic as well as arsenopyrite ore from the company's Irish Rose mine, near Battle Mountain. This ore contains an average of about 15 per cent of arsenic and some gold, silver, and copper. The Toulon arsenic plant makes 100 tons of crude white arsenic a month.

Utah ranks third among the states in the production of arsenic obtained from ores originating in the producing state. The ores received at the smelters in Utah average about one-fourth of 1 per cent of arsenic, and the possible output of white arsenic under normal conditions does not exceed 2,500 tons annually. Considerable arsenical ore that averaged over 20 per cent of arsenic was shipped from Gold Hill, Utah, to a lead smelter during the first six months of 1923, and some ore of lower grade was shipped to the insecticide works at Salt Lake City. Gold Hill promises to be the greatest source of arsenic in the United States for some time. Recent shallow prospecting at Gold Hill has opened a solid mass of arsenopyrite ore 20 ft. thick, but has not reached the country rock. At the Tintic Standard mill, at Harold, Utah, a small quantity of refined arsenic is being saved as a byproduct in the treatment of silver ore. The additional richer arsenical ore from Gold Hill that is being fed to the smelter furnaces and the equivalent of white arsenic recovered from ore at the insecticide works bring up the present output of Utah to 3,500 tons of white arsenic annually.

The smelting plant at Tacoma, Wash., treats speiss from Eureka, Nev., speiss from smelters in Montana and California, and considerable ore from Alaska, California, and British Columbia. The arsenic plant at Tacoma refines the dust from the company's smelting system, as well as considerable arsenical dust that is shipped from Utah. California and Alaska probably rank fifth and sixth respectively as sources of arsenic.

Several large undeveloped deposits of arsenical ore have been reported in Colorado, Montana, New Mexico, South Dakota, Nevada, California, Oregon, Idaho, and Washington, but none of these deposits has been investigated by the Geological Survey.

Wastage in Compressed-air Systems

Meter an Effective Aid in Checking Power Losses

By F. Johnstone Taylor

USERS OF AIR COMPRESSORS are likely to be exacting in their requirements when purchasing new machines, and those which meet with such requirements are costly. Added to the interest on first cost, are the present heavy charges for power or fuel and attendance, all of which make compressed air an expensive commodity to produce. Loss of air, therefore, besides nullifying any extra efficiency in production which would result from the installation of a first-class compressor, is an inexcusable waste of power, and it is the duty of maintenance engineers to see that not only are compressors themselves kept in the highest state of efficiency but that the system as a whole is free from every possible source of wastage. It is no easy matter however, especially in a busy factory or other plant, to find out just where such wastage is taking place, and the only satisfactory method of doing so is to install some means of measuring the output of air as a check on the power consumption of the compressor and so be able to account for any abnormal or unaccountable flow of air. Hence, reliable air meters are

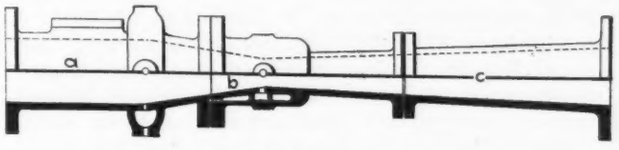


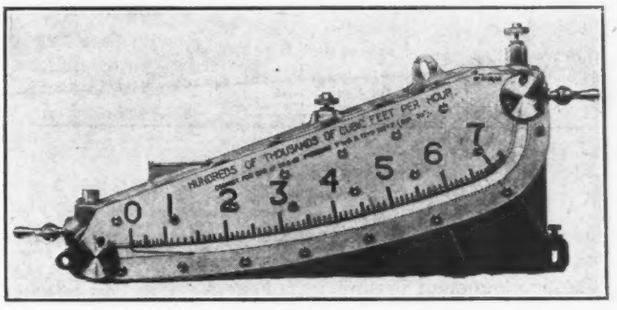
Fig. 1—A Venturi Meter

regarded as essential to an up-to-date plant, and are now obtainable at a reasonable cost, and, what is more important, they are accurate in operation, owing to recent improvements in both design and construction.

Air Meter an Efficiency Device

The use of an air meter for ascertaining the output of a compressor in order to compare it with the input in the form of power consumed is so obvious a means of checking the efficiency thereof that no comment should be necessary. Neither is the keeping of the mains tight any difficult matter provided they were originally well laid and a few simple precautions are taken. The main source of waste in the connections of a compressed-air installation lies in small, undetected leaks in branches and fittings, which in the absence of a meter are likely to go on unchecked for an indefinite period. This entails a continuous waste of fuel or power as the case may be. At a pressure of 70 lb. per square inch, as much as 20 cu.ft. of air per minute will escape through a $\frac{1}{8}$-in. hole, so there is little wonder that several small continuous leaks will render a compressed-air installation a luxury only to be tolerated when absolutely essential. Therefore the application of compressed air is restricted, but in most manufacturing processes it will, where judiciously handled, prove a valuable asset in operating labor-saving devices in addition to its more general uses. Meters intelligently used will prove a good investment.

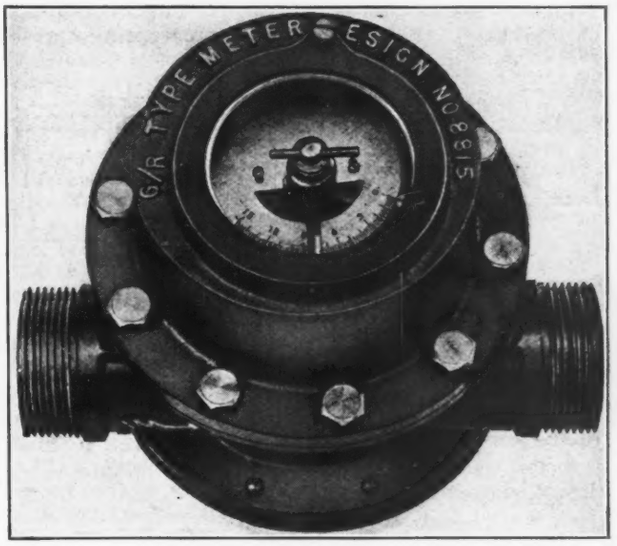
For large plants a type of meter operating upon the Venturi principle is both accurate and reliable, although it may be a somewhat costly piece of apparatus. In arrangement it is similar to the well-known Venturi meter as applied to the measurement of water, the principle of which is well known. That is to say, its operation depends upon the difference of pressure existing in a pipe line when part of that pipe line is purposely reduced in diameter. This gradual reduction of diam-



A curved-tube manometer

eter and the gradual bringing back of the pipe to normal diameter forms the essence of the invention.

The idea is shown in Fig. 1. The difference or pressure transmitted to the recording gear (not shown) is



A "gate" type flow-meter

that which occurs between the full diameter of the main at *a* and the parallel part of the throat section *b*. The function of the gradually diverging cone *c* on the downstream side is to nullify the loss of pressure caused by the insertion of the throat. These throat pieces, which have to be very accurately machined, can be changed if the maximum volume required to be measured becomes greater than that for which the meter was originally designed. The arrangement shown in Fig. 2 is known as the Orivent tube. It is essentially a cheaper

design than the Venturi, but is accurate, and, like the Venturi, can be altered to suit different flow conditions. It causes slightly more pressure loss than the Venturi, but the difference is small, amounting to only about 7 in. of water.

Both these instruments are suitable for dealing with the largest volumes of air at any pressure. For small plants and for installing on branch mains the various forms of orifice meter are much cheaper, and although they have not the accuracy of the Venturi type, they are, nevertheless, reliable and are accurate within "commercial" limits. Generally these orifices consist of a thin plate interposed between two flanges of the pipe. The arrangement is shown in Fig. 3. The two adjacent pipes are then connected by copper tube to a manometer in the same way that the Venturi or Orivent tube would be connected to its recorder. Again, the difference of pressure is the element made use of for calculating the flow, the plate really forming an infinitely short throat. Manometers are comparatively simple instruments which depend upon the movement of a column of liquid in a U-tube. The position of this column will vary under a difference of pressure, and this difference of pressure caused by the plate interrupting the flow

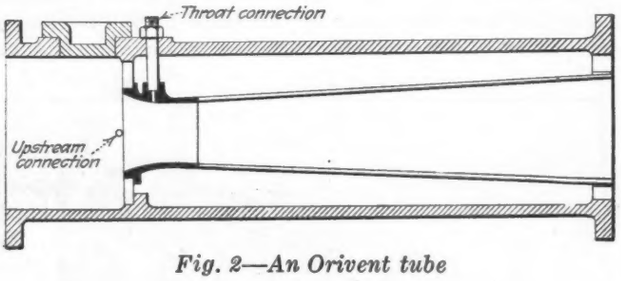
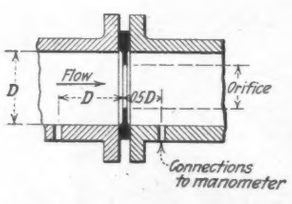


Fig. 2—An Orivent tube



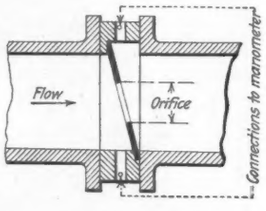


Fig. 3 and Fig. 4—Two types of orifice meters

is that made use of; hence the variation of the column in the manometer is a direct indication of the flow through the hole or orifice in the plate. That is to say if the difference of level or "head" in the U-tube is h inches the volume Q in cubic feet per minute bears a direct relation to h as follows

$$Q = \frac{100\ A}{\sqrt{\left(\frac{A}{a}\right)^2 - 1}} \sqrt{\frac{hp}{T}}$$

T being the absolute temperature of the air, p its absolute pressure, A the area of the pipe in square inches and a the area of the orifice in square inches also. This formula assumes the plate to be quite thin and to have square edges. These plates can, of course, be cut by a good mechanic, and manometers are obtainable as a stock line from instrument makers, but it is not a wise course to install air meters of a home-made description, but rather should the whole instrument be obtained from a firm making the work a specialty, because not only have they the greatest facilities for producing accurate ones but also the necessary facilities for calibrating them.

The curved-tube manometer provides an easily read rate of flow indicator for use in connection with a Venturi tube, Pitot tube, or orifice. As the flow varies as the square root of the pressure difference, the scale is cramped at low flows. To overcome this difficulty the manometer tube is curved so as to obtain an equally spaced scale from about $\frac{1}{16}$ of the maximum flow upwards.

Another form of plate orifice is that shown in Fig. 4 and it will be seen that it has the advantage of not requiring the pipes to be drilled for the connections, but contains these in itself, the slanting arrangement being necessary for the pressure pipes to have a clear entry. These latter are usually of copper and they must be freed from sharp bends and be laid with a regular slope for drainage. The recorder may be placed at any reasonable distance from the Venturi tube or orifice place as the case may be.

In addition to the Venturi system for large installations, and the orifice system for smaller ones, other forms of air meter are obtainable. Some of these utilize the mercury tube in place of the manometer. This pattern is specially useful for portable meters, a type which can be set up in a short time on any line on which it is desired to measure the flow. Such meters often have a recording drum with a set of dials, enabling the rate of flow to be integrated to show total flow or, as it is termed, "counter registration." If the rate of flow only is desired, the turbine meter is simple and reasonably accurate. As its name implies, its action depends upon the air passing being made to impinge on the blades of a turbine, which, through gearing, records on a dial its revolutions, which are calibrated to correspond to the rate of flow. Such meters are, however, unsuitable for measuring pulsating flows. For this purpose the gate type is often used and is specially suited to measuring air passing to rock drills and other small pneumatic tools of the piston pattern. As will be inferred, its action depends upon a gate suspended in the pipe and swinging with the pulsations of flow, and it is a very simple instrument. Its accuracy is sufficient for many purposes, the readings, in cubic feet per minute, being subject to correction for pressure and temperature, tables for which are provided by the makers.

If approximate efficiency is to be sought in a compressed-air system, the provision of meters will be nearly always found worth while. The output from compressors can be checked and any falling off of duty is readily indicated and can be immediately investigated and put right. Apart from this, a surprisingly great flow will take place at times when every possible source of escape is cut off. Often upon examining the pipe lines it will be found, especially on connection of hoses, that the mere tightening of a screw or union will save a tremendous number of cubic feet per day. Escapes of this kind are a constant loss and in the absence of a meter will probably go on undetected for an indefinite period, causing a continual loss of hard cash to the owners of the plant and generally serving to bring compressed-air systems into disrepute, whereas, although admittedly this form of power transmission is not ideal from many points of view, it is so extremely useful, convenient, and safe that the fullest and best use should be made of it in all modern mechanical industries.

Recent Technical Publications

Reviews, Abstracts, and References

A Monograph on Gypsum

Vol. 28 of the annual reports of the Iowa Geological Survey, containing the annual reports for 1917 and 1918, has just reached us. About 500 pages of the book is devoted to "Gypsum: its occurrence, origin, technology, and uses," with special chapters devoted to gypsum in Iowa. The discussion is comprehensive, covering the properties of gypsum; description of the important deposits of the world; the origin of gypsum and anhydrite; history of the industry; technology of gypsum and gypsum plasters; calcined gypsum; blocks, plaster board and wall board; structural gypsum; hydraulic gypsum and Keene's cement; retarders and accelerators; hardening and coloring; statistics; and an extremely complete bibliography. A special topographical map of the Fort Dodge area, in Iowa, is included. The author is Frank A. Wilder, who has made a study of the gypsum industry for twenty-five years. His work bears the mark of being up to date and attractively presented and his volume is certainly one of the two or three most important contributions to the literature of this mineral that have appeared. Other works of importance on gypsum are Stone's Bulletin 697 of the U. S. Geological Survey, Cole's report on gypsum in Canada, and Winterbottom's report for Australia.

The book is cloth bound in the fashion of two or three decades ago, the style doubtless being retained for uniformity. It may be obtained from the Iowa Geological Survey, Des Moines, Iowa, but we are unable to say whether or not it is available for free distribution.

Harold Bell Wright's Latest

Harold Bell Wright's popularity as a fiction writer is not to be disparaged, for his books sell into the millions, despite the fact that literary critics find little merit in his work. His latest book is "The Mine with the Iron Door." To prevent our readers from getting the impression that this volume covers the latest practice in mine ventilation or safety appliances, we feel that a brief mention of its contents may be desirable. We have not read it, but M. W. von Bernewitz sketches the plot for us as follows:

A couple of old prospectors find an orphan child, a girl, near the Mexican border and take her to the Canada del Oro, near Oracle, Ariz. There she grows into lovely innocent womanhood. A bad character in the village is always talking about her, and tries his hand. A tubercular doctor living near the prospectors teaches the girl, in lieu of a school. Enter an Indian who is really the hero of the piece. He spies everything from Apache Peak, and knows everything. Enter a tenderfoot prospector who digs gravel near the other prospectors. He falls in love with her and she with him. Enter the sheriff, who is after this tenderfoot, who, it seems, is fleeing from jail at Los Angeles, but really from wrongful imprisonment for a crooked deal done by a big financier. The Indian blindfolds the tenderfoot and takes him to the mine with the iron door, a Spanish antigua, and rich. Enter Sonora Jack and a band of ruffians who kill the old prospectors and carry off the girl across into Mexico, just by the Nariz Range. Then follow the Indian and the tenderfoot, the last-named having been proved innocent of the stock dealing mentioned, and the girl is saved. A few bags of specimen ore taken from the old mine brings prosperity to the couple forever after.

Our reviewer thinks it would make a good moving picture.

New England Granite—"The Commercial Granites of New England" are extensively discussed in U. S. Geological Survey Bulletin 738, 488 pages, obtainable on request from the Survey at Washington, D. C. The subject is presented in both its economic and general scientific aspects, the economic part including a chapter on the adaptations of New England granites, and another on the economic geologic factors in granite quarrying, with some practical suggestions. Little attention is paid to descriptions of individual quarry plants or purely technologic details.

Asbestos—"Mining and Manufacturing Asbestos Deposits," Part I of an article by W. G. Shanley, appears in the August *Arizona Mining Journal* (Phoenix, Ariz.; price, 20c.). The Arizona deposits have not yet been exploited to any extent, owing to the fact that the Canadian deposits are much more accessible, but the material is of excellent quality and the industry in that state shows signs of awakening.

Patents

Thickener—Canadian patent No. 230,898. May 8, 1923. The Dorr Co., New York City, assignee of W. A. Stedman, Westport, Conn. A method for hydraulically regulating the discharge from a Dorr thickener.

Flotation Machine — No. 1,457,077. May 29, 1923. T. A. Janney, Garfield, Utah. A flotation machine of the Janney type with individual motors attached to the agitator shafts, and means for introducing air through porous bottoms for floating the mineral in the agitated pulp.

Electrically Vibrated Screen — No. 1,458,111. T. J. Sturtevant, Wellesley, Mass., assignor to Sturtevant Mill Co., Boston, Mass. A screening device which is vibrated by electro-magnetic means, the support being stationary.

Screening Device — No. 1,455,785. May 22, 1923. G. C. Hackstaff, Denver, Colo. A screening apparatus made up of screens of various meshes, vibrated by electromagnets periodically energized, which act upon an armature attached to each screen.

No. 1,455,907. May 22, 1923. A. C. Daman, Denver, Colo. A cylindrical trommel with means for causing the shaft to gyrate in a flexibly mounted bearing.

No. 1,456,067. May 22, 1923. R. A. Leahy, Bonne Terre, Mo. An inclined screen for sizing granular material, the side edges of which are free to vibrate, and which is agitated by a device causing slow downward movement and an accelerated upward movement that is suddenly arrested.

Ore Separator—No. 1,456,165. May 22, 1923. S. H. Whitney, San Francisco, assignor of one-fourth to A. A. Eddie, San Francisco. A tank with a screw feeding device for an ore pulp, a suitable deflector, a receiving and discharge device at the tip of the conical bottom for the heavy particles of the ore, and means for discharging the lighter portions of the pulp around the periphery at the top.

No. 1,456,563. May 29, 1923. Alberto Noriega, New York City. A cone type classifier equipped with numerous conical deflecting plates.

No. 1,457,110. May 29, 1923. Rubert M. Gay, Hanover, N. J. This is an air separator making use of centrifugal force as well as air currents for the separation of fine light particles from coarse or heavy ones. It has received considerable application in non-metallic mills, and is known as the Gayco-Emerick separator.

Petroleum Industry—No. 1,457,479. June 5, 1923. E. R. Wolcott, Los Angeles. A method of operating oil wells consisting in closing the top of a central well, pumping air into the well, producing combustion therein, and pumping the surrounding wells.

No. 1,457,690. June 5, 1923. P. F. Brine, Boston, Mass., assignor to Oil Wells Renewal Co., Chicago. An electric heater for oil wells.

Gold Amalgamators—No. 1,457,560. June 5, 1923. H. C. Taber, Los Angeles, assignor of one-half to A. M. Jones, Los Angeles. A centrifugal amalgamator consisting of a cone-shaped vessel with several amalgam pockets and a large amalgam trap at the top, an inner cone, and means for revolving it.

No. 1,457,635. June 5, 1923. H. W. Richards, Portland, Ore., assignor to Score Mining Co., Portland, Ore. A method of supporting a rotary amalgamating barrel on skids.

Flotation Process — No. 1,457,680. W. A. Whitaker, New York City. On oxidized ore particles a film of an organic compound of the metal of the ore is formed by chemical reaction, this film having the characteristics necessary to make the mineral float when subjected to the ordinary froth flotation process.

USEFUL OPERATING IDEAS

A Mechanical Rocker

BY HENRY W. TURNER

IN TESTING gold placers for dredging it is customary to use some sort of churn drill, which secures a circular cylinder of the dirt, from 4 to 7 in. in diameter. The quantity of gravel obtained is therefore small and the estimate of the value of the gravel arrived at is evidently less reliable than when a larger amount of the dirt is used in the test.

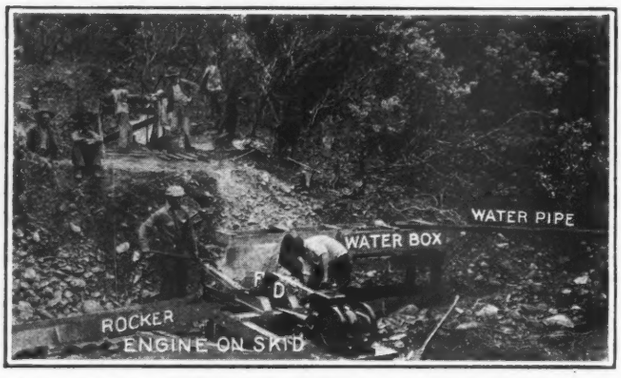


Fig. 1—Complete outfit, including rocker, engine, water and pipe. Shaft in background

Placer engineers generally therefore agree that shafts give much more reliable results, but unfortunately shafts are not practicable in most cases, on account of excess of water. However, there are many benches of comparatively dry gravel, so situated as to be available for dredging, and frequently portions of alluvial flats along rivers can, with the use of deep well pumps, be tested by shafts.

The mechanical rocker here described was used on bench gravel, containing little water and that naturally near the bedrock. This type of rocker is not new, having been previously used by the engineers of the Shasta Dredging Co., of California, and very likely by others. The accompanying illustrations show the construction and use of the machine.

Fig. 1 shows the entire outfit—the shaft, the rocker or long tom, the engine used to run the rocker, the water box, and the pipe for bringing the water to the water box. *F* is the eccentric shaft and *D* the pulley to which it is attached.

Fig. 2 shows the rocker outfit in more detail, together with the gravel box, which should be made to contain a definite amount of the dirt, one with half cubic yard capacity being a convenient size. *A* is the engine; *B* the handle of the hopper; *C* the leather end of the arm of the eccentric shaft, showing how this arm is attached to the handle of the hopper; *D* is the pulley; and *E* is the flume of the water box.

Fig. 3 shows in detail the material required to construct the machine, which is given as follows: A water box about 3x3 ft. x 10 in. is needed, also a flume from water box to run the water to the hopper. In this flume there is a gate to shut off the water when desired. The bottom of the lower end of the hopper is made of sheet iron, with holes punched to allow the water to fall on the dirt in the hopper. When water cannot be run into the water box by gravity from the surface, a deep well pump in a shaft with a 1½-hp. distillate engine will supply all the water required.

The hopper is about 3 ft. long and about 12 in. wide. It is placed with a slight grade away from the head of the rocker. The hopper thus has a slope in the opposite direction from that of the rocker. A transverse riffle in the rocker retains the dirt to be washed. This hopper operates perfectly, the coarse gravel and cobbles, after being cleaned of fine material, working their way automatically over the riffle and discharging on to the ground, without carrying off any of the dirt or the water. Thus the dirt containing the gold all finds its way to the rocker underneath. The bottom of the hopper is made of No. 14 sheet steel (thickness $\frac{1}{16}$ in.) and perforated with holes from $\frac{1}{4}$ to $\frac{5}{8}$ in. in diameter, placed about 1½ in. apart.

The size of the rocker is 12 ft. x 14x1 in., the bottom piece being 14 in. wide and of clear lumber (in California, sugar pine) without cracks or flaws of any kind. The sides of the rocker or long tom are 8 in. high and stand perpendicular to the floor. Some riffles can be placed on the bottom of the rocker. The lower end piece is of the usual curved shape to catch the concentrates and allow the light material to pass out.

The power is supplied by a 1½-hp. distillate engine *A*, with belt attached to the pulley *D*. This pulley is 15 in. in diameter and is on an eccentric shaft *F*. The engine is mounted on a skid of 4x6-in. timbers, with a 1-in. piece of iron and hook at one end to allow of attaching a chain or rope to drag the engine into position.

The eccentric shaft, *F*, which gives the mechanical shake to the rocker, has an offset of about 1 in. in the middle. Attached to the shaft is the hardwood arm which is connected with the handle of the hopper.

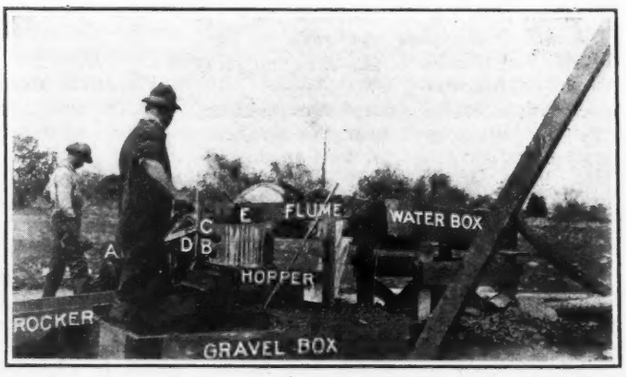


Fig. 2—A closer view of the equipment

The arm, *G*, to connect the eccentric shaft to the handle of the hopper is made of hardwood, with an aperture, *H*, at the lower end to allow of the insertion of the shaft. At the other end is a piece of strong leather, *C*, to go over the handle of the hopper. The centers of the two apertures of the arm (*C* to *H*) are 26 in. apart. The speed of the pulley must of course be regulated to give an even shake to the rocker.

A convenient size for a prospecting shaft is 2x5 ft., which allows the miner a free swing for his pick. After completing the shaft it should be measured every five

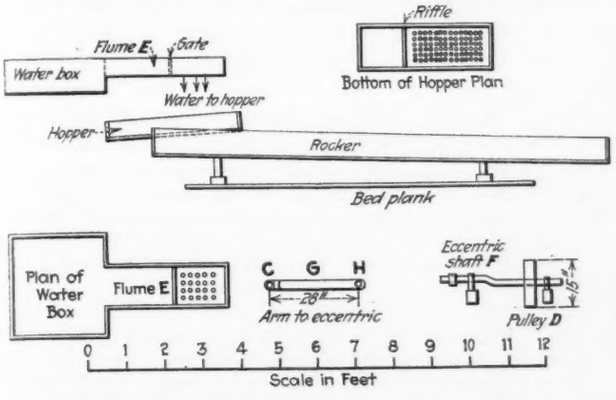


Fig. 3—Sketch showing material required for construction of outfit

vertical feet. Generally it will be found to be a little smaller at the bottom, especially if there is water trouble. In this case, as the gold is largely near the bedrock, evidently a smaller proportional amount of the richer gravel will be extracted. This can be used as a factor of safety, or in some cases an increase in the estimated value of this bottom gravel may be allowable, on account of a smaller amount being extracted as compared with the poorer gravel above.

As the shaft to be sampled is often at a considerable distance from the rocker, canvas sacks (say about 17x 24 in.) can be used to transport the gravel from the shaft to the rocker. Each sample should include not more than five vertical feet of the dirt of the shaft, and consequently, as each five feet is excavated, it should be sacked and tagged at once.

By using this mechanical rocker, 5 cu.yd. or more per eight-hour shift can be put through the rocker. In this way the entire gravel taken from a shaft can be washed economically and rapidly. To make sure that no gold is being lost, as is possible with clayey material, a pan of the tailing should be washed at intervals.

Suction-draft Eliminator for Obnoxious Gases

By Charles Flury
French Mining Concession, Taiyudong, Korea

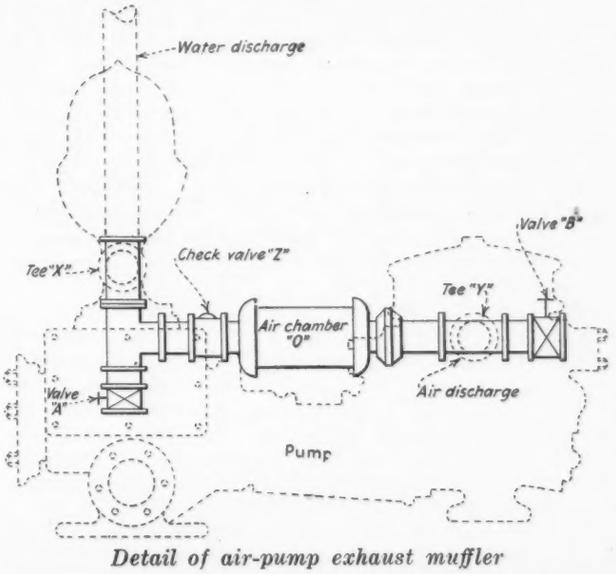
The application of a device for removing obnoxious gases became necessary in our clean-up department after it was decided to submit all the gold precipitates from the zinc boxes to sulphuric-acid treatment. In contrast to the action of coarse precipitates, the fine gold-slimes react with sulphuric acid, forming hydrogen sulphide, arsene, and hydrocyanic acid very rapidly. In several instances the man in charge of agitation at the acid tanks became unconscious. The apparatus built to remove these gases is arranged on the principle of acceleration of draft by the introduction of a jet of compressed air in the chimney base. A suction is produced much in the same way as in a water-jet vacuum pump. Thus the gases evolved are drawn toward the air injector and quickly discharged afterward by the positive blowing force of the air jet.

Muffler for Air-pump Exhaust

By Roy H. Poston

In shaft sinking or in small stopes where an air pump is necessary, the resulting noise from the exhaust is almost deafening. To overcome this in a southeast Missouri lead mine, the exhaust air from the pump was sent up through the water column with the pumped water, all necessary fittings being taken from stock or made up in the mine shop. These fittings were of the standard size for use under pressures for which the pump was employed. Turning the exhaust air into the pump column will cut down the capacity, or, rather, the efficiency, of the pump somewhat, but most pumps do not run at full speed or capacity.

Tees *X* and *Y* are placed at the water and air exhausts, where they emerge from the pump, as shown, and the special piping is placed between these tees. Valves *A* and *B* serve as "bleeders" or outlets for use when the pump is started. The air chamber *O* is made of a short section of pipe about three times the diameter of the rest of the air line. The check valve *Z* prevents any water from flowing back into the air line. Fittings from the air exhaust pump outlet to the air chamber *O* are of the same size as the standard air exhaust line of the pump used and those from the water exhaust to the air chamber *O* are the same as would ordinarily be used at this point.



Detail of air-pump exhaust muffler

When starting the pump, it is usually necessary to open the valve *B*, thus allowing the exhaust air to escape in the regular manner until the pump has picked up its lead. The valve is then closed slowly. It is sometimes necessary to manipulate valve *A* in the same way.

If this special fitting should become clogged or for any reason fail to function it is only necessary to keep valve *A* closed and open valve *B* wide and the pump will operate as if connected in the ordinary manner.

CONSULTATION

The Meaning of "Proof of Labor" in the Californian Code

"I have been asked to write you in regard to recording annual assessment work. The case is as follows: A valid location has been made, and annual assessment work has been performed each year for several years. The assessment work for 1922 was completed according to law, but a 'Proof of Labor' was not recorded until some time in 1923. The claim was jumped on the ground of non-recording of 'Proof of Labor.' Notices were posted on the ground stating that assessment work had been completed and it was locally known that the work had been done. Will you kindly advise me through your columns as to which claimant, original or jumper, can hold the claim.

CALIFORNIAN."

In order to obtain an expression of opinion much more authoritative than our own, we asked the Hon. J. W. Thompson, of Washington, to state the law in this case and to give his opinion. He informs us in a letter from which the following extracts have been taken that the claimant cannot have his claim taken away from him merely because of an oversight or failure to file his "Proof of Labor." Extracts from the letter follow:

"The federal statute cannot require the record of an affidavit making proof of assessment work anywhere except in Alaska. This is a matter residing entirely with the states for the reason, as you will readily observe, that Congress has no power to compel a county officer to perform any service for the public.

"The Mining Code of California, Section 1426 (*m*) provides that a mine owner or claimant who has performed the assessment work or made the improvements required by law, or someone in his behalf, shall, within thirty days after the time limited for performing such labor or making the improvements, have recorded by the county recorder in the proper county, an affidavit setting forth the value of labor or improvements made, and certain other data. The affidavit, or a certified copy, is *prima facie* evidence of the performance of such labor or the making of such improvements.

"You will observe that the California code says the claimant shall file the affidavit within thirty days, etc. The word 'shall' used in this connection can mean nothing more than the word 'may,' as it is not within the power of a state to render a mining claim open to forfeiture for the mere failure of the locator or claim owner to file the proof. The claim is valid for all purposes if the assessment work is actually performed, as this is the requirement measured by the U. S. Mining Statutes.

"The requirement for recording and the record of affidavit in proof of the performance of the required labor is nothing more than a convenient form of making the proof in case of controversy that might arise over the validity of the claim. If the affidavit is not filed as recorded, proof may be made the same as if there was no such requirement by the state statute.

"The California code does not pretend or undertake to make a claim open to forfeiture for failure to file the affidavit as required; and as suggested above it could not do so if it attempted to make the forfeiture.

"I beg to refer to the following cases: Musser v. Fitting, 148 Pacific, 536; Robinson v. Briest, 173 Pacific, 88."

The Adsorptive Properties of Silica

The following letter requests some information which we are unable to supply regarding tripoli. Tripoli is a soft and friable form of amorphous silica generally considered to be of the chalcedony variety, as it is double-refracting. Perhaps some of our readers have data that will aid our correspondent, whose letter follows:

"In following out some of our research work, we have been drawn into investigations of the *adsorptive properties of tripoli*, and I have personally become much interested in some of the results and the possible bearing on the formation of orebodies, perhaps because previously I had been for years in the mining business.

"Of course, our investigations so far have not even scratched the possibilities, and there is a great deal to be done before we can arrive at any broad conclusions.

"Some of this work has been with the adsorption of substances held in solution by water, and we have found, for instance, that with St. Louis tap water, 1 per cent of tripoli, with the water at room temperature, adsorbs 20 per cent of the calcium salts and 20 per cent of the magnesium salts.

"A subsequent test with the same water and same proportions, but at a heat of 170 deg. F., gave no adsorption of calcium salts and 26 per cent of the magnesium salts.

"I was particularly struck by the effect of heat as compared with normal temperature; and I find myself wondering to what extent adsorption by the silicas under different conditions can effect not only the formation of orebodies but of the non-metals.

"Can you tell me if anything has been written on the subject of adsorption of silica, and if you have done any work along this line? I am quite sure that considerable work has been done in this, but I can't get in touch with it.

"Seneca, Mo. G. V. B. LEVINGS."

Roasting Pyritic Material for Sulphur

"I would be much obliged for information on the use of small reverberatory furnaces with settling chambers and flues, to be fired by charcoal, wood, anthracite, or bituminous coal, for making sulphur cakes from iron pyrite. The simplest plan possible is desired, such as could be built on the spot where only bricks and fireclay are available, with little iron work possible. The ore contains about 35 to 45 per cent sulphur, mixed with a small amount of galena and sphalerite. The capacity desired is about 200 tons monthly of melted sulphur to be produced in the form of cakes; or flowers of sulphur can be produced and cakes subsequently melted and cast."

We have no record of the publication of the details of such a furnace as is required. If any of our readers are familiar with work of this kind and care to submit the desired information we shall be glad to forward it to the inquirer and also to publish it if it seems of sufficient general interest.

Small reverberatory furnaces have been described in several books, notably "General Metallurgy," by H. O. Hofman, and "Handbook of Metallurgy," by Schnabel. The first is published by McGraw-Hill and the second by Macmillan. A reducing atmosphere would of course have to be maintained to prevent oxidation to sulphur dioxide, and suitable condensing chambers provided.

MEN YOU SHOULD KNOW ABOUT

Charles Henry White has returned to San Francisco from Mexico.

A. M. Donoghue, assistant treasurer of the Texas Company, is in Washington, D. C.

E. J. Carlyle passed through San Francisco recently on his return to Pasadena, Calif.

Roy H. Elliott, mining engineer, of San Francisco, has been in Reno and other Nevada points.

Lester W. Strauss, who arrived in the United States from Chile on June 18, will return to Valparaiso in September.

Vincent P. Gianella has been appointed instructor in metallurgy at the Mackay School of Mines for the coming year.

Frederic R. Weekes has gone to Toronto as manager in Canada for the Porcupine Goldfields & Development Co., of London.

R. S. Lienau left New York on Aug. 18 to assume the position of factory manager of the American Mining Co. of Santa Fé, N. M.

R. E. Somers, of the University of Pittsburgh, has been appointed geologist for the Greensboro Gas Co. and the Chartiers Oil Co.

S. F. Shaw has completed an inspection of mines in the El Carmen district of Durango, Mexico, and has gone to the Mazapil district.

Alfred Whitman, geologist, of the University of California, is making an examination of the Castle Trethewey mine of Gowganda.

H. S. Denny, of London, who has spent a month in the Salmon-Bear rivers district of British Columbia, has left Stewart for London.

George S. Bailey, field engineer of the Day interests, has recently completed an examination of the Laurier mine, at Laurier, Wash.

A. T. Thomson, assistant to the president of Phelps Dodge Corporation, of New York City, is visiting the company's properties in Arizona.

J. S. Brown, of the staff of the U. S. Geological Survey, has accepted a position in the Department of Geology of the Missouri School of Mines.

Walter Clark Teagle, president of the Standard Oil Co., was in Toronto on Aug. 14, and held a conference with the officials of the Imperial Oil Co.

A. B. Parsons, of the *Journal-Press* staff, has returned to New York after spending four weeks in Michigan, Minnesota, and northern Ontario.

John Borg, of New York, president of the Callahan Zinc-Lead Co., is inspecting the operations of the company in the Coeur d'Alene district, Idaho.

Dr. Walter Harvey Weed, of New York, mining geologist and engineer, is at Wallace, Idaho, engaged in professional work for the Callahan Zinc-Lead Co.

R. H. Stewart, formerly general manager for the Consolidated Mining & Smelting Co., has been examining properties in the Portland Canal division of British Columbia.

Hugh Rose, manager of Mexican mining interests for the Consolidated Gold Fields of South Africa, Ltd., has been in Nevada inspecting preliminary operations of the Comstock Merger Mines Co.

Dr. Francis Church Lincoln, director of the Mackay School of Mines of the University of Nevada, has tendered his resignation to take effect on Sept. 1.

Dr. Francis Church Lincoln

Dr. Lincoln is resuming private practice as a member of the firm of Hindry, Boyle & Lincoln, with headquarters in Reno.

Dr. E. L. Bruce, of the Ontario Department of Mines, is investigating the recent report of the discovery of gold at Red Lake, in the District of Patricia, where silver-lead was found last year.

Dr. L. D. Ricketts, a director and consulting engineer, and **William Wraith,** vice-president of Inspiration Consolidated Copper Co., have spent several days at Inspiration on a visit of inspection.

Dr. Alfred C. Lane, professor of geology at Tufts college, and his wife and daughter are spending a few days in the Michigan copper district. Dr. Lane was formerly State Geologist of Michigan.

Walter Hovey Hill, who has been developing a large shear zone of milling gold ore in the Salmon River country of Idaho for a party of Pittsburgh people for three years, is in New York on business.

D. M. Levy has returned to South Africa from Brazil, and **H. Stuart Martin,** M.I.M.M., consulting engineer to the Central Mining & Investment Corporation group of mines, has returned from South Africa to London.

Charles McCrea, recently appointed Minister of Mines for Ontario, was the guest of the citizens of Sudbury, Ont., on Aug. 16, at a picnic attended by about 10,000 people, who presented him with a congratulatory address.

R. W. Stone last week addressed the Rotary Club of Harrisburg, Pa., on the anthracite situation, and the Pennsylvania district foresters' convention, at Mount Alto, on the service rendered by the State Geological Survey to the public.

J. E. Spurr and **A. H. Hubbell,** of the *Journal-Press* staff, spent the week of Aug. 20-25 in the mining districts of northern Ontario as members of the party attending the convention of the A.I.M.E. now being held in Ontario and Quebec.

Colonel Rowland C. Fielding, an English consulting engineer, has arrived in Canada and is on his way to make an inspection of the Porcupine and Kirkland Lake gold fields on behalf of a syndicate of British capitalists.

E. S. Moore, professor of economic geology at the University of Toronto and director of the Royal Ontario Museum of Geology, is making a tour of the principal mining districts of British Columbia, and, incidentally, collecting representative specimens for the museum.

Frank Morrison has resigned his position as field engineer with the Freeport Sulphur Co., Freeport, Texas, and has gone to California. **D. T. McIver,** formerly in the engineering department of the Texas Gulf Sulphur Co., has accepted a position with the Freeport Sulphur Co.

G. H. Ashley, State Geologist of Pennsylvania, spent the first half of August in the French River country, Ontario, Canada, and also visited the Sudbury district. This week he is in the mountains near Altoona, Pa., in conference with **W. C. Mendenhall** and **Charles Butts,** of the U. S. Geological Survey.

C. F. Kelley, president, and **B. B. Thayer,** vice-president, of the Anaconda with **Charles F. Brooker,** chairman of the board of directors of the American Brass Co., have been making a tour of inspection of their various Montana properties. They were accompanied by **James R. Hobbins,** in charge of Montana operations for Anaconda; **John Gillie,** general manager of mines, and **Frederick Laist,** general metallurgical manager, in charge of smelting and refining plants.

OBITUARY

Roy A. Young, president of the Electric Point mine, near Northport, Wash., died at Eagle, Alaska, on July 27.

Robert Henry Flaherty, mining engineer, died in Port Arthur, Ontario, on Aug. 15, at the age of sixty-seven. Mr. Flaherty had long been identified with the mining industries of Canada.

THE MINING NEWS

The Mining News of ENGINEERING AND MINING JOURNAL-PRESS is obtained exclusively from its own staff and correspondents, both in the United States and in foreign fields. If, under exceptional conditions, material emanating from other sources is published, due acknowledgment and credit will be accorded.

Leading Events

REORGANIZATION of Metals Exploration Co. follows break between Bulkeley Wells and H. P. Whitney. Negotiations for acquisition of United Comstock by Consolidated Gold Fields may be reopened.

The Mesabi Iron Co. will increase the capacity of its concentrator at Babbitt, Minn., to 400 tons of finished sinter per day.

Shortage of water has caused further curtailment of output in Joplin-Miami district.

Utah copper mills are grinding 44,000 tons of steam-shovel ore per day.

An arrangement has been made whereby the A. S. & R. Co. will operate the Duthie mine, in British Columbia.

A bonus or bounty is proposed to stimulate the development of an iron-ore industry in Ontario.

The Walker Mining Co. doubles the capacity of its plant in Plumas County, Calif.

The East Butte Copper Co. has taken over the Hoffman property, at Elkhorn, Mont.

The United States company is building modern new bunk and change houses at Bingham, Utah.

Current gold production in South Africa is curtailed by shortage of native labor.

A second nickel furnace has been blown in by the British America Nickel Co. at Sudbury.

New high records for production have been established by the Dome and Nipissing mines, in Ontario.

Walker Doubles Capacity of Flotation Plant in California

The new flotation mill of the Walker Mining Co., a subsidiary of the Anaconda Copper Mining Co., in Plumas County, Calif., is expected to be in operation early in October. The capacity of the old mill was doubled in 1917. In 1922, 38,652 tons, averaging 5.62 per cent copper, was milled, and the capacity of the plant was increased to 275 tons per day. Recent additions will permit the treatment of 750 tons per day by fine crushing and flotation. Ore reserves have been augmented, and profitable operation for a considerable period is anticipated.

Copper Country Operators Want C. & H. Consolidation

Feeling in mining circles in the Michigan copper district is that the proposed consolidation of Calumet & Hecla, Allouez, Ahmeek, Centennial and Osceola will be consummated. Not an expression of dissent has been heard. It appears to be generally recognized that consolidation will bring greater stability to the industry in the Lake region; that proposed fabrication of copper and brass products will increase the earnings of the "new" company; that operating costs will be considerably reduced through centralization of work in all departments; and that suspension of mining will not again be necessary. It is regarded by men familiar with the properties and the possibilities to be the most progressive step ever taken in the Michigan district.

New Cornelia Employs 1,300 Men at Ajo, Arizona

Foundations of "Sulphide" Mill Under Way—Should Start by Nov. 1

The main structure of the New Cornelia concentrator, at Ajo, is about completed and ready for the installation of the machinery. It is expected that the erection of foundations will be started at once and that the plant will be rushed to completion and actual operation begun by Nov. 1. The company is operating three steam shovels twenty-four hours a day, and there are at present about 1,300 men on the payroll, including those engaged in the construction of the concentrator.

It is planned to start the operation of the new mill on a small scale, increasing the tonnage treated as the production from the sulphide orebody replaces that of the oxide ores. The oxide ores will probably be mined for four or five more years and operation of the leaching plant continued for that time in conjunction with the running of the new plant.

Only 44,000 Tons Per Day to Utah Copper Mills!

Shipments of ore by the Utah Copper Co. of Bingham, Utah, to its Arthur and Magna mills during July, are placed at 15,296 cars, or 1,225,680 tons. The daily average of shipments is 550 cars, of 80 tons each, or, about 44,000 tons per day. This means that the company's mills are being operated at normal capacity, which is at a rate of production of about 20,000,000 lb. of copper monthly.

No Leaching Plant for Inspiration for the Present

A statement appearing recently in a number of Arizona newspapers to the effect that the Inspiration Consolidated Copper Co. was planning to erect a 10,000-ton leaching plant for the treatment of low-grade mixed ores at Globe has been denied by Dr. L. D. Ricketts, director and consulting engineer for the company. Considerable experimental work has been conducted at the Inspiration mill during the last few years and a small leaching plant has been maintained for test purposes. This work was discontinued during the time the mine was not operating in 1921 and was resumed only a few months ago. However, the process has not been perfected, according to Inspiration officials, and the company has no intention of constructing a new plant at the present time.

Trail Ore Shipments

Following is a statement of ore received at the Trail smelter of the Consolidated M. & S. Co of Canada during the period Aug. 1 to 7, inclusive:

Name of Mine	Locality	Tons
Alamo mill	Alamo, B. C.	44
Black Rock	Northport, Wash.	200
Henderson group	Smithers, B. C.	40
Knob Hill	Republic, Wash.	162
Lone Pine Surprise	Republic, Wash.	272
Paradise	Lake Windermere, B. C.	44
Quilp	Republic, Wash.	267
Silversmith (zinc)	Sandon, B. C.	79
Silversmith (lead)	Sandon, B. C.	128
Standard (lead)	Silverton, B. C.	17
Standard (zinc)	Silverton, B. C.	18
Van Roi	Silverton, B. C.	53
Company mines		9,139
Total		10,463

R. H. Channing, Jr., Succeeds Bulkeley Wells as Administrative Head of Metals Exploration Co.

Difficulties of United Comstock and Other Subsidiaries Cause a Break Between Wells and H. P. Whitney—Deal with Consolidated Gold Fields Off for Present

San Francisco, Aug. 20—(By wire)—The resignation of Bulkeley Wells, vice-president and managing director of the Metals Exploration Co., recently announced from the San Francisco office of the company, and the appointment of Roscoe H. Channing, Jr., president of the Utah Consolidated Mining Co., as his successor, without doubt indicates a reorganization of the affairs of the Metals Exploration Co. and its subsidiaries, among which are the United Comstock Mines Co., in Nevada; the Idaho-Maryland Mines Co., the Lewiston Dredging Co., in California; the Cache Creek Dredging Co., in Alaska, and the Anna Beaver Mining Co., in Oklahoma. The company is privately owned and financed by H. P. Whitney and his associates. Wells has been in direct charge of the operations of the company, which has maintained offices in San Francisco, Denver, and New York.

Gold dredging and lode mining have been the chief activities of the company. The Radium Company of Colorado was successfully operated for a time. The Valdor Dredging Co. was unsuccessful, as well as the Gold Canyon Dredging Co. Large expenditures were made upon the property of the United Comstock Mines Co. at Virginia City, and the Idaho-Maryland at Grass Valley.

Denver, Colo., Aug. 16—It is reported that Bulkeley Wells, managing director, and Fred Farrish, consulting engineer, for the Metals Exploration Co. have resigned. The Denver office of the company is silent so far as confirmation or denial of the report is concerned.

The Metal Exploration Co. is a close corporation in which Harry F. Sinclair, oil magnate, and Harry Payne Whitney, New York capitalist, are the dominant factors. The company controls the "Sulphate" process for beneficiating low-grade and complex zinc ores. A plant to use this process is now being erected at Durango, Colo. Besides the Smuggler-Union mine, near Telluride, the company operates the United Comstock properties at Virginia City, Nev.

Dissatisfaction with the results of their large expenditure in financing the latter project, as well as others, led to a break in the friendly relations which have existed for years between Mr. Wells and Mr. Whitney, it is believed.

Reno, Nev., Aug. 16—It is reported that there is a probability of a consolidation of various Comstock Lode holdings, including the United Comstock Mines Co., the Comstock Merger Mines Co., and possibly Consolidated Virginia and Ophir. Results of the conference between Hugh Rose, representing the Consolidated Gold Fields of South Africa, Ltd.; Bulkeley Wells, representing the United Comstock Mines Co., and Herbert Humphrey, promoter of both the United Comstock and the Comstock Merger, have not been made public. Such a consolidation would undoubtedly mean mining, milling, and development on a larger scale than at present, with the always present probability of the discovery of another bonanza orebody, for which the Comstock Lode has been famous.

The United Comstock is operating a newly built mill having a rated capacity of 2,500 tons per day. The plant cost several million dollars.

The Consolidated Virginia and Ophir mines, on the North End of the Comstock Lode, are producing, and the Mexican and others are about to be developed, following a recent discovery in the Ophir above the Sutro tunnel level. The properties composing the Middle Mines group have been under exploration and development by the British company for over a year.

New York, Aug. 21—Negotiations on the part of the Consolidated Gold Fields of South Africa involving a controlling interest in the United Comstock Co., operating at Virginia City, Nev., are off for the time being at least. Hugh Rose has returned to Mexico and A. F. Keene, of New York, is on his vacation. Whether the idea will again be considered is problematical, according to other officials in the New York office.

Capacity of Babbitt Concentrator Will Be Increased

Eight Hundred Tons of Sinter Daily Objective of Mesabi Iron Co.

The Mesabi Iron Co., through its president, D. C. Jackling, has announced the installation of additional machinery at its concentrating plant at Babbitt, Minn., to increase the present capacity 100 per cent. The present rated capacity is 400 tons of sinter per day and this is limited only by the one sintering machine at present installed and the classifying equipment, as all other production factors, such as power, crushing, and grinding, can more than handle the contemplated increased output. The coarse-grinding department can handle at present 5,000 tons of crude material per day, which would reduce to 1,600 tons of sinter, and the intermediate and fine-grinding departments can handle 2,500 tons of crude material, to make 800 tons of sinter.

The report farther states that additional shares of stock will be issued and sold by the company to take care of this new work and that the plant as a whole has proved satisfactory and in many instances above expectations.

East Butte Buys Mining Property at Elkhorn, Mont.

The East Butte Copper Co. has taken over the Charles Hoffman holdings, at Elkhorn, Mont. They adjoin property owned by the East Butte Co. The newly acquired ground is considered to be one of the best properties in the Elkhorn district. Development work will be started immediately that will require approximately thirty men.

The reopening of this property means a great deal to this camp, as very little work has been done there in the past three months.

Mohawk-Wolverine-Michigan Merger Approved

Formal approval of the merger of the Mohawk, Wolverine and Michigan copper mining companies was given Thursday, Aug. 16, by stockholders of the three companies. L. P. Yandell, president of all of them, announces that the plan called for the exchange of all the stock of the Wolverine and Michigan companies for new additional shares of the Mohawk company, presently to be issued. Details of the basis of exchange were not made public.

Bonus Proposed to Stimulate Canadian Iron Mining

Half Billion Tons of Magnetite Ore Available—Present Production Nil

The special committee appointed by the Ontario Government in October, 1922, to investigate the iron-mining industry of the province has handed in its report. The committee emphasizes the fact that though Ontario has large iron ore resources, no iron ore is being produced today in the province, or, as a matter of fact, in Canada, and that this country is dependent upon a dwindling foreign supply that is within reasonable distance of extinction. The committee feels that under proper conditions a market could be found in Ontario for approximately 750,000 tons of sintered ore a year. To encourage this production, the committee recommends a bonus of 1 cent per unit of iron in each long ton of merchantable iron ore produced, beneficiated, and marketed from Ontario deposits. It is recommended that the bounty be paid for a period of ten years.

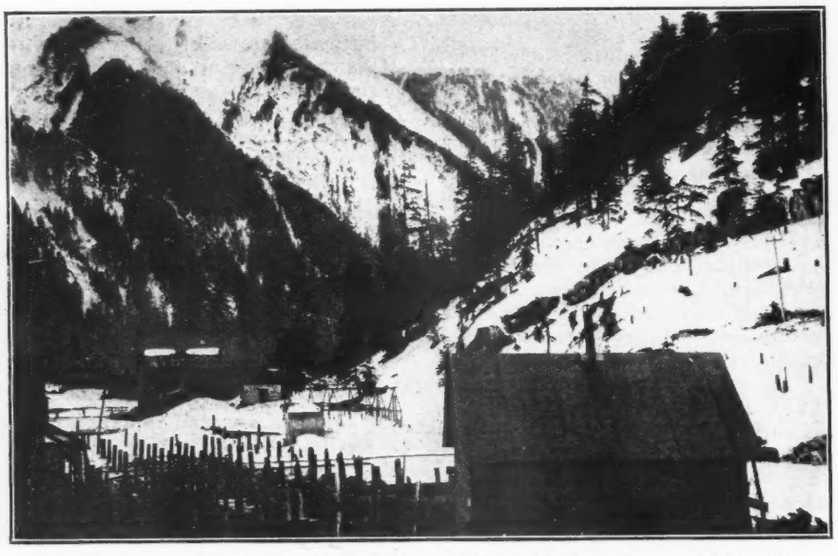
There is in the Province of Ontario approximately 500,000,000 tons of proven iron ore, with additional large acreages and deposits which have not been explored. The ore, however, consists almost entirely of magnetite, which must be concentrated and beneficiated. The result, however, is a merchantable product of high iron content. The development of this industry would give a great stimulas to trade and commerce throughout the country and would make the province practically independent of foreign sources of supply. It is believed that if the industry is once established on a producing basis it will within ten years be self-supporting.

Federal Christens Huge Fire-Fighting Plant at Idaho Mine

Demonstrates New Equipment for Fire Chiefs—Fourteen Streams Available at Once

A remarkable demonstration of fire protection was recently given by the Federal Mining & Smelting Co. at the Morning mine, at Mullan, Idaho. The occasion was the visit of over 100 delegates to the annual meeting of the Pacific Coast Fire Chiefs' association, which was being held in Wallace. The Federal company, under the direction of H. L. Hanson, master mechanic, had just completed the installation of a marine gasoline engine built by the Sterling Engineering Co. This new system was supplemental to the old system, the pressure being obtained by gravity and the supply of water being obtained from two creeks on the opposite side of the canyon from the mill. The new system takes the water direct from a large flume that supplies the mill, the engine, with a multiple stage Cameron turbine pump directly connected, being just beneath the flume, thus having a practically inexhaustible and dependable water supply.

A gasoline tank just above the flume holds 300 gal., enough to run twenty-four hours. On this occasion a battery of fourteen streams were turned loose from hydrants and turrets with swinging nozzles distributed at points of advantage throughout the large mill yard. Following this exhibition ten streams were brought into action that covered the great piles of stulls and the company boarding house, four stories high, and on the roof of which a dozen sprays were in action that quickly saturated the roof. It was altogether a wonderful exhibition, the equipment and installation representing a large expenditure by the company, and appears to be the last word in fire protection for mill and mine surface plant.



Looking up Salmon River Valley from Hyder, Alaska, above which galena ore has recently been found

Galena Discoveries Excite Prospectors in Portland Canal District

Good Showing on Texas Creek—Pat Daly Sings Praises of Ore—Two Hundred Claims Staked

Something of a stampede from Hyder, Alaska, was caused recently by Joe Jackson and Joe Neary, who located a vein of galena at the head of the west fork of Texas Creek and brought samples into Hyder, which assayed $74.35 in gold, silver and lead. According to the locators, the vein ranges from 3 to 8 ft. in width and has been traced for 7,500 ft. A number of prospectors went out, among them Charlie Carlson and Jim Hewitt, who found and located another vein of galena, five miles nearer to Hyder, samples from which ran 65 oz. in silver and 65 per cent of lead. Then the rush started, and about 200 claims were staked.

Texas Creek flows into Salmon River from the north at Eleven-Mile. Pat Daly and associates have secured a half interest in the Carlson-Hewitt claims, and Pat avers that it is the best surface showing that he has seen in the district; but then, Pat, coming from the Kootenays, always had a proclivity for galena. That is said to be why he missed the Premier, on which he had an option after Colonel Thompson gave it up and before R. K. Neill discovered the famous orebody.

British America Nickel Starts Second Furnace at Sudbury

The second furnace of the smelter of the British America Nickel Corporation at Sudbury, Ont., has been blown in and both furnaces are now in operation, treating approximately 1,000 tons of ore daily. There is a marked shortage of labor, and the force employed in the mine and smelter is only between 500 and 600 men. The corporation could employ 150 more.

Water Shortage Shuts Down Joplin-Miami Mills

Compels Further Curtailment—Recent Reduction in Output Observed by Most Companies

Persistent hot dry weather in the Joplin-Miami district has resulted in a steadily growing shortage of water for milling operations that seems likely to become acute for many mines unless rains occur. At this writing, Aug. 16, a number of mines have shut down for lack of water and others will have to at the end of the week unless it rains.

Among the mines that had to close during the week on this account are the Mary Ann, near Hockerville; the Commonwealth No. 1, in Picher; the Skelton Lead & Zinc Co.'s No. 4 mill; the Dorothy Bill; and the H. & M., located east of Cardin. The latter property is installing a water line to Tar Creek, but this is a matter of only temporary relief, as the creek is almost dry. Other mines that expect to have to close unless it rains are the Rialto, the Domado, the Black Hawk, and the Underwriters Land Co.

The shortage of water is thus contributing unexpectedly to the curtailment of operations put into effect a few weeks ago. This is still in effect at many of the properties.

A. S. & R. Co. Will Operate Duthie Mine, in British Columbia

Examination Reveals Good Showing—New Equipment Being Installed

The Federal Mining & Smelting Co., a subsidiary of the American Smelting & Refining Co. has bought a controlling interest in the Duthie mines property near Smithers, British Columbia. It will proceed to take over the management at once. H. A. Guess, and Dale L. Pitt, general manager of the Premier mine, have just completed an examination of the property, which consists of the Henderson, Mamie, and Hanna groups of claims. The principal work has been done on the Henderson, from which more than 200 tons of high-grade has been shipped to the Trail smelter.

Mr. Guess says that aggressive development will be started at once, and that the ore would be shipped by way of Prince Rupert to the Selby smelter, on San Francisco Bay. The same engineers also examined the operations at Dome Mountain, where the Dome Mountain Mining Co., a subsidiary of the Federal Mining & Smelting Co., is exploring the Jefferson group, with satisfactory results. A power plant and compressor is being erected.

Charles Wethered, formerly of Wallace, Idaho, will have charge of operations at Duthie mines. J. F. Duthie, who is said to have spent a quarter of a million in development, equipment and purchase of the properties, will retain an interest in the new company that will be formed to operate the mines. It is said that Duthie is to receive $250,000 in cash.

News from Washington

By PAUL WOOTON
Special Correspondent

Economics of Non-Ferrous Metal Mining To Be Analyzed

Geological Survey Will Assist Senate Gold-Silver Commission—H. N. Lawrie Publishes Facts on Gold and Silver—Correlates Sundry Statistics

AT THE REQUEST of the Senate Commission of Gold and Silver Inquiry, H. A. C. Jenison, geologist of the U. S. Geological Survey, has been detailed for work with the commission to make an analysis of operating conditions in the non-ferrous metals industries of the country.

In this work for the commission, Mr. Jenison will have the assistance of G. F. Loughlin, chief of the division of mineral resources of the Survey; J. P. Dunlop, chief of the metal section; and C. E. Siebenthal, specialist on lead and zinc, who will help in the study while carrying forward their usual work with the Survey.

Questionnaires are being prepared and will be sent out by Mr. Jenison at an early date.

In announcing the analysis to be made by Mr. Jenison, Senator Tasker L. Oddie, chairman of the commission, said:

"The commission sincerely hopes that mining operators will lend every aid possible to Mr. Jenison, so that these analyses may determine accurately the conditions under which the industry has been carried on since 1905. With such a statement of facts from those who have the knowledge and practical experience to present them, the commission will be greatly assisted in its investigation and in developing such remedies to safeguard the industry in the future as the facts may indicate are necessary."

Outlining the study to be made by Mr. Jenison, the announcement states:

"Mr. Jenison will make a detailed analysis of the costs of production, the investment and yield on investment in the gold, silver, copper, lead and zinc industries, together with an analysis of the problems of taxation, excess production capacity, integration of the industries into logical economic units, labor supply, and the importance of these metals to foreign trade. As most of the silver and a substantial part of the gold produced in this country are produced as incidental to the mining of copper, lead, and zinc, a thorough knowledge of these three non-ferrous metals is fundamentally necessary to a correct and complete understanding of the gold- and silver-mining industry. This part of the commission's investigation assigned to Mr. Jenison will be made as complete and as thorough as possible and should result in an accute determination of the past, present, and probable future status of the industry and the causes of the present depressed condition."

A thorough compilation of gold and silver statistics has been completed and sent to the printer by H. N. Lawrie, who has charge of the details of the inquiry for the commission. The volume will be ready for distribution among the mining men who attend the conference called by the commission at Reno on Sept. 4. Mint statistics of production and Department of Labor figures on wholesale prices over a range of years have been harmonized and compared by Mr. Lawrie in this book, which forms probably the most valuable work on the concrete subject that has been drafted. The statistics are presented in tables and by charts, and a general index by subjects have been prepared.

World production of gold and silver is presented in this book, with statistics of production in the United States from 1793 to 1922, inclusive. Sources and recovery by treatment are presented in detail. To get down to basic problems, Mr. Lawrie has prepared comparisons of the purchasing power of gold and of silver by figures on the wholesale commodity-price lists from 1840 to 1922, with silver prices from 1874, taking the 1913 dollar as 100. Other chapters of the book deal with imports and exports of the metals; monetary and industrial consumption; the number of deep mines, placers and dredges producing gold and silver in the United States.

Dome and Nipissing Make New Production Records

NEW production records were broken in July by both the Dome Mines, of Porcupine, and the Nipissing, of Cobalt. The Dome output for July was $425,547, an increase of $4,000 over the highest previous month. The Nipissing produced 298,000 oz. of silver, which is the highest month for the present year. The estimated net value was $168,200, and the refinery shipped bullion of an estimated net value of $159,500.

News from Mining Districts

By Special Correspondents in the Field

Melbourne Letter

Antox Smelter Progresses—Fire in Central Mine—New Tin Smelter Starts Operation

BY PETER G. TAIT

Melbourne, July 17.—Antox, Ltd., which is operating on the antimonial-gold deposits at Costerfield, Victoria, is making good headway with the new smelting plant. The power plant is in place, and the smelting equipment should be on the site during August. The mill is producing concentrates averaging over 60 per cent stibnite and about 2 oz. gold per ton. Ore on hand for milling averages 12 per cent stibnite and 10 dwt. gold. A reef in the mines, now being stoped, shows higher gold values. John J. Doyle, is general manager.

On Tuesday, July 10, a fire was discovered at the 400 level of the Central mine, Broken Hill, owned by the Sulphide Corporation, Ltd., and notwithstanding strenuous efforts it is still burning fiercely. The aim of the fire fighters is to prevent the fire from spreading to the other levels or to the adjoining South mine. Broken Hill mines are well equipped to deal with underground fires, as they have had previous experience of the trouble involved in extinguishing them. In 1896 a serious fire occurred in the Broken Hill, Pty., Co's. workings and it did not burn out until ten years later. This was followed by another fire, which obtained such a hold that a section of the mine had to be isolated. In 1916 a third fire occurred in the same mine and is still burning. About seventeen years ago there was also an outbreak in the Broken Hill Junction mine, and to extinguish this the Junction, Junction North, and North mines were flooded. It is too soon at present to say what the result of the Central fire will be, but James Hebbard, the general manager, hopes that it will be possible to keep the outbreak under control.

A few days ago Messrs. O. T. Lempriere & Co., a well-known firm of metal buyers, formally opened a modern tin-smelting plant in Sydney. For the last thirty years this firm has been one of the principal buyers of tin concentrates in Australia. Prior to the war it acted as the representative of the Straits Trading Co., Singapore, but latterly its purchases were treated by the Mount Bischoff Co. at Launceston, Tasmania. F. B. Jackson, who had control of the Mount Bischoff smelters for nearly twenty years, has been appointed manager for the new works.

During June 52,426 oz. of gold was exported from the commonwealth, at a gross average price of £4 3s. 7d., equal to £4 10s. 1d. per ounce. After deducting costs of realization and exchange, the net return will be £4 8s. per ounce.

Johannesburg Letter

Labor Shortage Cuts Gold Output — Tailing for Brick Manufacture to Be Used

BY JOHN WATSON

Johannesburg, July 17—The Transvaal gold output for the month of June was declared by the Chamber of Mines, on July 10 as 755,309 fine ounces, having a realized value of £3,361,125. This is a decrease of 31,255 oz., value £119,420, compared with May. The working days in June were one less than in May, and the realized price showed an increase of 1s. 6d. per ounce. The daily average shows a decrease of 82 oz. compared with May. The decrease is attributable to shortage of native labor, the Labor Association returns showing a decrease of 4,726 "boys" employed on the gold mines. Compared with last February, there is a reduction of 9,401 in the number of natives working on the gold mines. Brakpan Mines make a special return of 3,335 oz. of gold from amalgamating plates, as that property is now adopting the corduroy method. New State Areas makes its first declaration, 1,768 oz. from low-grade rock.

The mine dumps of the Main Reef series are sometimes described as the Alps of the Witwatersrand. At the instigation of W. Ingham, samples of sand from the George Goch, Ferreira, and Robinson Deep mines were washed free from cyanide, and sent, along with samples of lime from the Transvaal, to a Glasgow engineer, who took them to works on the Continent of Europe, where sand-lime bricks are being manufactured. The ratio is said to be 95 sand to 5 per cent unslaked lime. A South African company has been formed and has ordered equipment, which it is said will turn out 56,000 bricks per day at a cost of 27s. 6d. per 1,000. The present price in Johannesburg for faced bricks is £4 10s. per thousand. A specimen faced brick was brought to *The Star* office, in this town, a few weeks ago, which gave forth a clear metallic ring and seemed to fulfill all the requirements of a good faced brick.

On the Johannesburg Stock Exchange, business up to mid-week was stagnant. On Wednesday afternoon, Thursday and Friday inquiries came to hand and an improvement was shown, both in prices and volume of business. City Deeps improved about 2s. per share, and Crown Mines and Van Ryn Deeps have gone up about 1s. 6d. on the week's balance.

The following dividends have recently been declared for the past half year:

	Dividend No.	Rate of Dividend Per Cent	Per Share
Government G-M. Areas	12	30	6s.
Langlaagte Est. & G. M. Co.	64	10	2s.
Van Ryn Deep, Ltd.	20	25	5s.
Witwatersrand G. M. Co.	38	15	3s.
Johannesburg Consolidated Investment Co.	—	12½	2s. 6d.
Pretoria Portland Cement Co.	31	7½	1s. 6d.
Wit. Deep, Ltd.	29	7½	1s. 6d.

London Letter

English Investors Urged to Form Shareholders' Protection Association

BY W. A. DOMAN

London, Aug. 9.—This is the real holiday season, and it is on this account that there is no sensational mining news to report. In other words, a suggestion is made that good news—if any—is being saved up until markets are better and the public is inclined to purchase shares. The great milch cow, the British investor, is being given a rest. The South African mining companies with their dividend warrants are inclosing a notice stating that the amount would be greater if it were not for the burden of taxation, which probably is more onerous in their case than anywhere else in the world. The suggestion is made that shareholders should approach their members of Parliament, with a view to getting taxation reduced. The matter is, in any case, making investors think, and a proposal is put forward in London to form a Shareholders' Protection Association.

Many mining companies have been in existence for years and have never returned one penny in dividends to those who subscribed the capital. Reconstruction follows reconstruction, and the same management is retained, the directors and officials being provided with easy and remunerative billets. In some cases it certainly is a scandal, but the British investor, when he has lost his money, simply shrugs his shoulders and says he went in for a gamble and has lost. Even the agitators among shareholders—like the politicians—can be won over by a seat on the board of directors.

The Rand gold-mining companies are benefiting by the depreciation of sterling, and for the last month they sold their gold at £4 9s. 3d. per fine oz., less 1s. 9d. for exchange and realization charges. To some extent this compensates for the high taxation and labor costs, but, being artificial, it is unhealthy.

The return for July of the San Francisco Mines of Mexico is regarded as disappointing, for though almost 1,000 tons of ore extra was treated the net smelter return is only $100,185, against $100,915 for June. Operating costs were slightly lower, so that there was a small increase in the profit of $57,925. Capital expenditure is rather heavy, and amounts to $36,000, which presumably is provided by the operating profit.

The output of copper for July by the Union Minière has exceeded expectations and is a record, amounting to 5,720 tons. For the six months to June 30 the production was 24,528 tons, so that there is every probability of last year's output of 43,300 tons being considerably exceeded. This is certainly an achievement for the "heart of Africa"!

The Broken Hill Proprietary company during the twelve months ended May 31 last reports a net loss of £106,086 after providing £155,304 for depreciation and £131,277 for debenture interest. The loss is not so much due to the price of metals as to the fact that for the greater part of the period the steel works were closed down. The reopening took place in February. The shutting down originally was due to high wages, and also to the excessive cost of coal. This matter has now been settled, and because in normal times the steel works employ about 5,000 hands and the total number dependent on the works and allied industries is about 20,000, local opinion is jubilant on account of the settlement.

BRITISH COLUMBIA

Iva Fern Will Be Developed

George H. Aylard, president of the Standard Silver-Lead Mining Co., has announced that his company will start at once to drive an adit 1,800 ft. from the new discovery at the Iva Fern mine. This, besides exploring another part of the vein, will give an additional depth of 350 ft. on the oreshoot. Should this work prove satisfactory, a mill will be erected. In the meantime, a power plant will be developed on Cultous Creek and a compressor erected, to expedite the work of driving the adit and of exploring the vein from the tunnel. W. H. North is manager.

Hercules Changes Hands

Montreal and Toronto capital has secured a controlling interest in Hercules Mines, which owns a group of claims adjoining the Big Missouri, at the Head of Slamon River valley, and R. L. Clothier has been placed in charge of development operations, which have been restarted. The company did some exploration work in 1920. A good deal of surface work was done and a tunnel was driven 200 ft. to develop surface showings at depth, without finding ore.

High-Grade Ore in Combination Mine

The uncovering of a new lead of high-grade ore in the Combination mine of the Eholt Mining Co. has put new life into the mining town of Greenwood, B. C. The discovery was made about 230 ft. from the portal, and good values in gray copper and silver are reported to be established. Drills are to be put to work immediately further to prove the orebody, and a shipment to the Trail smelter is planned. The Combination was located in 1892.

Kimberley Mill Started

The new concentrator of the Consolidated Mining & Smelting Co. built to dress the ore of its Sullivan zinc lead mine at Kimberley has been started. The plant covers twelve acres, and its designed capacity is 2,500 tons daily. The total investment of the company in mine, mill, and appurtenant improvements is said to be $4,000,000.

Reduced Smelting Rates Help Tintic, Utah, Mining Companies

A REDUCTION of smelting rates on the siliceous silver ores of Eureka, Utah, by the American Smelting & Refining Co., just announced, will mean much for the district. The reduction in some cases amounts to $1 per ton. The ores are treated at the Garfield plant, which some time ago made changes and improvements for treatment of ore of this character. The company has been receiving considerable excess iron ore, so that it is enabled to increase its consumption of siliceous ores and at the same time reduce smelting rates. Production in Tintic should be stimulated.

ONTARIO

"Blue-sky" Law Nullified in Province

Early in the present year the Government of Ontario, which was then in power, passed a "blue-sky" law, but provided that it was not to come into force until proclaimed on the first of September. Since that time a new government has come into power, which opposed the passage of the act, and this government has decided not to have the law proclaimed, which will make it non-effective. The government believes that "blue-sky" legislation would tend to give a degree of the government sanction to speculative securities and that it would retard the development of the country's natural resources.

No Decision of Wage Increase

The Conciliation Board appointed by the Dominion Government to investigate the claim of the Porcupine miners for an increase in pay of 20c. per hour has not been able to come to a decision. The board has suggested that the companies and the miners get together and settle the dispute among themselves, but so far no action has been taken.

ARIZONA

New Dominion Ready to Crosscut

The shaft of the New Dominion Copper Co., at Globe, has reached a depth of 1,175 ft., and during the next two months crosscuts will be driven to the vein. This company began development work in January, and since that time has reconditioned the shaft from the surface to the former bottom, at the 800 level, and continued sinking to the present depth. As soon as the 1,200 level is reached, a station will be constructed and a crosscut will be driven to the south to intersect No. 1 vein. The shaft has been in strongly mineralized material for the last 50 ft. and specimens of chalcopyrite and bornite ore containing 20 to 30 per cent copper have been found.

The New Dominion property is just north of the Old Dominion mine, and veins that show likely croppings on the surface, and which approximately parallel the Old Dominion vein, are being developed at depth. The mine was formerly opened to the 800 level, and a well-mineralized vein averaging about 8 ft. wide was opened at that horizon. On the 800 level, one wall of the vein is diabase, but at the 1,200 level and below the vein is expected to occur entirely in sediments, a condition that has been found to be most favorable in the Globe district.

William Porri, superintendent in charge, looks for important developments during the next few months.

CALIFORNIA

San Francisco Correspondence

Fire Losses Continue Heavy

Fire continues to take its toll in Californian mining camps. On Aug. 5 the lumber yards and sawmills of the Engels Copper Mining Co., three miles north of the company's mine in Plumas County, were destroyed by a forest fire. On the same day a serious fire destroyed an important section of the surface equipment of the Hoff Magnesite Co., operating near Porterville, in Tulare County.

Priest River Miners Will Increase Capacity of Co-operative Mill

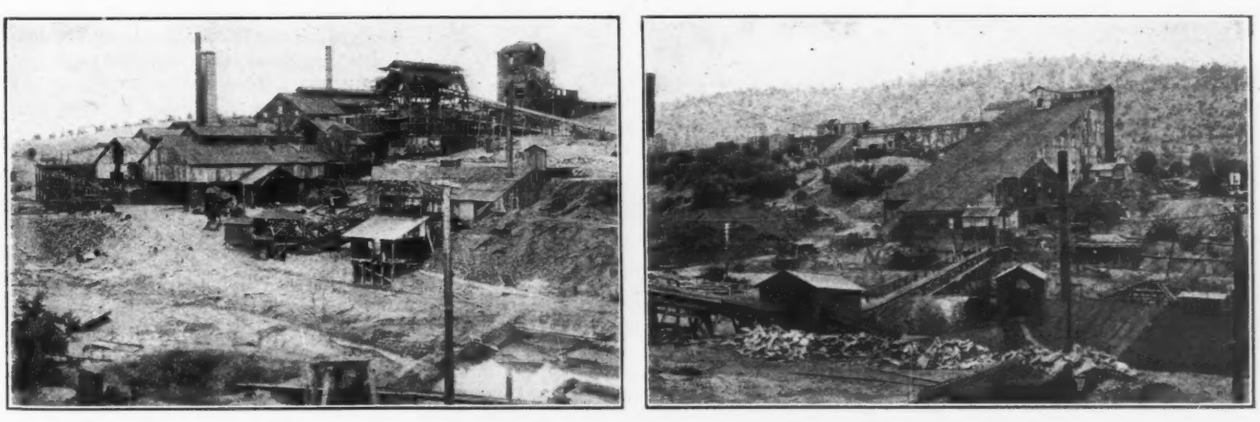
A SMALL co-operative concentrating plant recently erected at Priest River, Idaho, with funds raised by selling stock to residents of the locality, to treat the ores from the various prospects, has proven inadequate. So much ore has been sent that plans are under way to increase the capacity of the plant. The mill is now handling ores from the Gold Coin, Bob Kane, Lakeside, Snowshoe, Black Marie and Black Prince mines. It is claimed that funds are available for enlarging the mill without further sale of stock.

Some of the properties in the vicinity are being bonded to Priest River people who have faith in the mines and prospects of the district.

Forty-eighth Victim of Argonaut Disaster Still Missing

In spite of the fact that nearly twelve months has elapsed since the disaster in the Argonaut mine, no trace has been found of the remains of William Fessel. It will be recalled that the fire occurred in the main shaft on Aug. 27, 1922. On Sept. 18, connection was made from the Kennedy mine, adjoining. The bodies of forty-seven men were found in the 4,350 level, behind a rude bulkhead made of old clothing, which had been improvised after the fire started.

However, William Fessel, the forty-eighth, known to have been in the mine after the fire started—because a message written by him was found on the walls of the level, indicating a realization of impending disaster—was not among them. The work of searching for the remains continues, but it is hindered by the caving that has occurred. It is estimated that some sections of the mine cannot be explored for several months, although work to that end is progressing.



Smelter (left) and mine plant and mill (right) of the Calaveras Copper Co. This copper producer in California recently resumed production after a long period of inactivity

WASHINGTON

Two Shippers in Keller District

In the Keller district, the Addison Copper Co. has let contracts for hauling crude ore from its mine to Wilbur, a distance of 30 miles. The Iron Creek mine is sacking high-grade ore from a new winze on the 175 level. This will be hauled over the same roads as used by the Addison Copper Co. The ores from these mines will be shipped from Wilbur by rail to the Bunker Hill smelter.

Bead Lake Output Increased

The Bead Lake mine, near Newport, has put on a double shift and is pushing its mill to capacity. The concentrator has been thoroughly overhauled and some new equipment added, together with motors and transformers and a transmission line. Shipments of concentrates will begin immediately to U. S. Smelter at Midvale, Utah.

OREGON

Alaskans Take Over Oriole

The Oriole mine, in the Galice district, west of Gold Hill, an old-time producer and in litigation for some years, has been sold to Alaskan people, Harry Sordy, of Grants Pass, is in charge; he will reopen the mine. The vein is opened on four levels to a maximum depth of 500 ft. below the outcrop and 325 ft. between levels. The mine is equipped with water wheel for generating electric power for driving the mine equipment and 10-stamp mill. The ore average is $20 per ton in gold.

Gold Hill Properties Active

F. H. Andrews, of Gold Hill, has opened a rich 10-ft. gold-bearing vein in abandoned workings adjoining the Sylvanite mine, three miles north of Gold Hill. The owner has purchased an adjoining ranch for the purpose of developing spring water to supply a mill which will be erected. The Sylvanite, Millionaire, and Gold Ridge mines are operating in the Gold Hill district.

Much development work is being done on other producing properties in the district with a view of resuming.

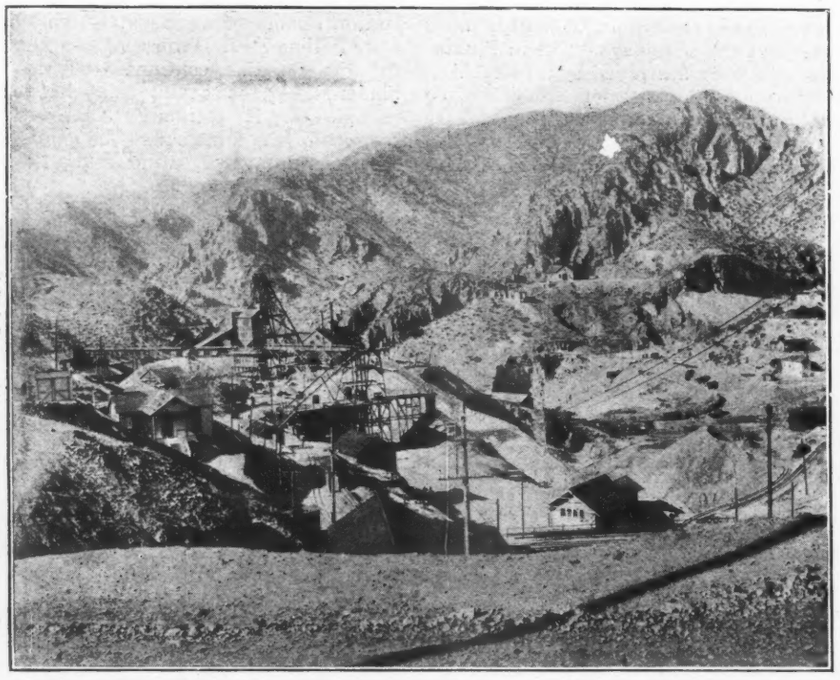
Spokane Stock Exchange Does Some "Blue-skying"

THE Spokane Stock Exchange has authorized the appointment of a vigilance committee to investigate companies, mines, or sales methods that have been questioned. The attention of the association has been called to many instances of law violations by unscrupulous salesmen advancing properties of no merit. The information obtained will be sent to state officials at the state capital. It is proposed to work with banks and other organizations in weeding out "shark salesmen."

An information bureau on the exchange will be open to free use of interested parties wishing to investigate various mine securities.

Hecla Dismantles Old Smelter

The Hecla Mining Co. has taken over the old smelter plant of the Granby Consolidated Mining & Smelting Co. at Grand Forks, and the work of dismantling has begun. The material is to be shipped to Burke, Idaho, for use in the construction of a new concentrating plant.



Phelps Dodge Corporation's Mining and Milling Plant, Morenci, Ariz.

NEVADA

New Development at Divide

The Kernick Divide reports favorable developments in the crosscut and drift on the Kernick tunnel level. The crosscut has entered the main vein and a drift has been driven on the vein for over 50 ft. The vein, as exposed in this drift, averages 4 ft. in width and runs about $15 per ton. There are high-grade spots throughout the vein and some of the ore is said to resemble the Tonopah Divide ore. This work is in new territory and chances are regarded as very good for the finding of profitable orebodies.

Tonopah Divide Ships Regularly

The Tonopah Divide Mining Co. is operating normally and making regular shipments to Tonopah custom mills. Information regarding the underground conditions and ore tonnage and values is lacking, as the present management has not given out regular reports on operations, as formerly was done.

Candelaria Mills and Makes Money

The Candelaria Mines Co. continues to operate its mills at capacity, treating 300 to 400 tons of ore per day, mostly from old fills. It is said that present operations are profitable and permit of a development program which may prove successful in finding new orebodies, in which event the mine would continue to operate.

MONTANA

Clark Interests Reopen Evilyn Mine

After a personal inspection of the surface of the Evilyn claim by Senator W. A. Clark, orders have been given to reopen the old mine at once.

The Evilyn mine, once a good silver producer in the early days of the Butte district, has not been worked for several years. It is in the northwestern part of the district in the silver-zinc area.

The hoist and compressors that were formerly used on this property have been in use at the Travona mine (another Clark property), and as this property has not been worked for a long time, this machinery will be set up on the original foundations and anchor bolts again, as they are in very good condition. This will facilitate and hasten the installation. A new headframe has been constructed.

The shaft is only 400 ft. deep, but has made a good record as a silver producer. A large crew of men will be employed as soon as work on the surface plant is completed.

Midwest Ships From Two Mines

A. M. Chisholm, of Duluth, president, and Harry A. Mundy, of St. Paul, treasurer, of the Midwest Mining Co. are making an inspection of the Garabaldi and Prospector mines, both of which are in the southwest part of the Butte district. Recent zinc-silver ore shipments made by this company are gratifying to the officials.

UTAH

Shipments from Utah Mining Camps

Park City companies shipped during the week ended Aug. 10, 2,791 tons of ore and concentrates, compared with 3,310 tons the week preceding. Shippers were Silver King Coalition, 1,225 tons; Park City Mining & Smelting Co., 908 tons; Park-Utah, 658 tons.

Eureka mines shipped 130 cars, as compared with 156 cars the week preceding.

Shipments from Bingham amounted to 85 cars. Shippers were United States Mines, 46 cars; Utah Apex, 31 cars; Bingham Mines, 8 cars. This is exclusive of Utah copper and Utah consolidated shipments.

United States Erects New Bunk House and Change Room

The United States Mining Co. is also making new plans for the comfort and convenience of its employees at Bingham. The company will build a bunk house capable of housing 150 men and a change room for 300 men. The bunk house is arranged so that there is one room for every two men. Baths, electric lights, and all modern conveniences will be provided. There will be a kitchen and dining room. The change room will be erected over the portal of the Niagara tunnel, so that the men may enter it directly through a stairway without going outside.

JOPLIN-MIAMI DISTRICT

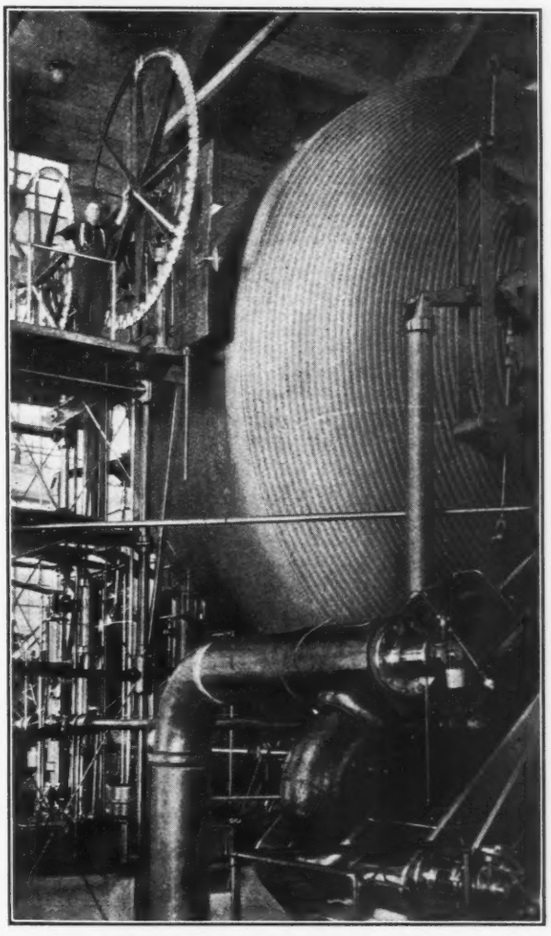
The Burch Lead & Zinc Co. has started the erection of a small mill on its lease near the old Klondike field, northwest of Joplin. Work of development of the lease was started just a year ago, and strong water has held back operations. A 12-in. Downey pump is being used for unwatering work. The main orebody is found at about 130 ft.

Freehold No. 4 Mill Started

The Freehold Oil & Gas Co. has begun operation of its new No. 4 mill in the Waco, Mo., field. The plant is on the Olson land, east of the High Five mine of the American Z. L. & S. Co. Work of construction of the mill was started in May, but the floods of May and June handicapped building activities. The plant is steam driven and has a capacity of 200 tons per ten-hour shift. The main orebody is found at 225 ft. The company's No. 2 and No. 3 properties are producing steadily, dirt from both being handled over the No. 3 mill. The field shaft at the No. 2 recently was sunk into a good body of ore.

Development Progresses; Shaft Sunk

Shaft sinking is being carried on by several companies, among them being the Admiralty Zinc and the Empire Development Co. The latter company has approximately completed its new field shaft, north of the mill. It is being put down to a depth of 240 ft. The company plans to handle 1,000 tons of dirt daily as soon as this shaft is well opened and the mill put in operation again. It has been down since the first of July on account of the unsatisfactory ore prices. Considerable repairing has been done at the mill. The Admiralty Zinc Co. has just installed a compressor on its Kane lease and is proceeding to sink a shaft to tap the orebodies proved up by drilling operations. Three of the four mills of the company in the Oklahoma field are being operated, but only on the five-day-a-week schedule. M. B. Lawrence is manager.



Quincy (Mich.) No. 2 hoist, "largest" in the world

Drum diameter, 30 ft.
Steam cylinders, high 32x60; low 60x66.
Weight of skip, 10 000 lb.
Weight of 10,000 ft. of rope, 41,500 lb.
Time for one trip of 10,000 ft., 4 min. 8 sec.

MICHIGAN

Mayflower Cuts Conglomerate on 1,450 Level

At the Mayflower property, in the copper country, a conglomerate formation opened on the 1,700 level has been encountered on the 1,450 level. This is an important discovery in a geological way for Mayflower, as it provides knowledge of the trend of the Mayflower vein in this part of the property. The ground is badly folded in Mayflower, and because of faulting and changing in direction of the mineralized ground, Mayflower has had to feel its way along and gain its own knowledge of the geological make-up of its property. It is believed that the conglomerate just cut in the 1,450 level will solve present difficulties and that the vein can be picked up again. It apparently is the key to the whole situation in this part of the mine. As a result of the discovery, the lateral will be turned at right angles to again pick up the vein.

The conglomerate itself is without values. It was quite extensively opened on the 1,700 level, but little copper was found. On the bottom level, an improvement is showing in No. 2 drift.

New Franklin Shaft Will Be Hastened

Franklin's new shaft on the Kearsarge lode is down 25 ft., still in overburden. A temporary compressor and hoist have been installed and progress from this time on should be rapid.

Good "Rock" in Winona

Winona continues in rich rock in the 12th level drift, south, in No. 2 King Philip shaft. The vein is wide, a crosscut to determine the width having been extended over 20 ft. The showing is the best ever opened in the Winona.

THE MARKET REPORT

Daily Prices of Metals

Aug.	Copper, N. Y. net refinery* Electrolytic	Tin 99 Per Cent	Tin Straits	Lead N. Y.	Lead St. L.	Zinc St. L.
16	13.625@13.75	38 875	39.25	6.55	6 35@6.40	6.35@6.40
17	13.70 @13.75	38.75	39.125	6.55	6.35@6.40	6.40
18	13.70 @13.75	38.625	39.00	6.55	6 40	6.40
20	13.70@ 13.75	39.125	39.50	6.55	6.40@6.45	6.40@6.45
21	13.75	39.125	39.50	6.55	6.45	6.45
22	13.75	39.625	40.00	6.55	6.45	6.50
Av.	13.727	39.021	39.396	6 550	6.413	6.425

*These prices correspond to the following quotations for copper delivered: Aug. 16th, 13.875@14.00c.; 17th, 18th and 20th, 13.95@14.00c.; 21st and 22d, 14.00c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

The quotations are arrived at by a committee consisting of the market editors of *Engineering and Mining Journal-Press* and a special representative of the Bureau of Mines and the Bureau of Foreign and Domestic Commerce.

London

Aug.	Copper Standard Spot	Copper Standard 3M	Copper Electrolytic	Tin Spot	Tin 3M	Lead Spot	Lead 3M	Zinc Spot	Zinc 3M
16	63⅞	64⅛	69½	184⅝	186	23¾	23¾	32⅛	31⅞
17	63½	64⅜	69¼	185	186	24	24	32¼	32¼
20	63⅞	64⅛	70	186	187	24	24	33¼	32⅝
21	64¼	65	70¼	187	188	24⅛	24⅛	33⅜	33
22	64⅞	65¼	70½	190½	191½	24⅛	24½	33⅛	33⅛

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

Aug.	Sterling Exchange "Checks"	Silver New York	Silver London	Gold London	Aug.	Sterling Exchange "Checks"	Silver New York	Silver London	Gold London
16	4.56⅜	63⅛	31 1/16	90s 2d	20	4.55⅛	63	31 1/16	90s 5d
17	4.56⅛	62⅞	30 15/16	90s 2d	21	4.54⅝	62⅞	31	90s 9d
18	4.55½	62⅞	31	.....	22	4.54⅞	62¼	30⅞	90s 5d

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-quarter of a cent premium.

Metal Markets

New York, Aug. 22, 1923

The week's business in the non-ferrous metals does not exhibit much change from the preceding period. Both zinc and lead are slightly stronger; the copper market has also improved from a small sag, but ends the week in the same position it occupied seven days ago. The outstanding development has been the beginning of export sales of zinc to European consumers, to whom heavy tonnages have been allotted. In all the metals the improvement of London prices has helped materially in buoying up the markets. Although the situation abroad is still grave, it would appear that sufficient activity is taking place to furnish an intermittent demand for the non-ferrous metals.

Copper

Last Thursday copper was obtainable and was sold for 13⅞c. per lb., delivered, which was the lowest price for the week of which we have any record. One consumer reports being able to purchase the metal for a few days following at the same price, but this is not borne out by the sales that have actually been made, as during the remainder of the week copper was sold pretty generally at the 14c. level. Good-sized tonnages were sold, considering the light nature of the demand for the metal during the last few months, and practically all producers participated in the market. In the latter part of the week several million pounds were also sold at 13.95c. per lb., delivered, but this is as far as we have heard the 14c. price to be shaded. Today it is difficult to pick up copper below 14c. Consumers have been interested in all positions up to the end of the year. One producer reports selling copper at 14c. for delivery by months through December; another states that prompt business has been the feature of his sales, with a noteworthy lack of forward inquiry. Production of copper is running at a merry rate and causing some producers a little concern, but no disposition is shown to let up.

The export demand has been fair, and the competition for the business of foreign consumers continues active. Buying has been well distributed abroad; even Germany, despite her chaotic financial affairs, has been a purchaser. Prices have netted American producers close to the domestic market level.

The copper situation is getting interesting. The marked buying wave which has been expected for almost five months has not materialized. Nevertheless, at least one refiner declares that he is having difficulty in catching up with his orders and that the copper is literally being shipped hot from the plant. There is a danger that once buying commences in heavy volume the price of copper may advance too suddenly.

Lead

The official price of the American Smelting & Refining Co. continues at 6.50c., New York.

The St. Louis market has been more active than that at New York, and prices have risen under the stimulus of the demand for western metal. Today the market in St. Louis is 6.45c., at which level the metal has been sold. At least one producer is asking 6.50c. Judging from the behavior of the market during the last few weeks it would appear that the production of lead was curtailed about the same time that consumption fell off. The disastrous fire in the Coeur d'Alenes which destroyed the Hecla plant made a great hole in Idaho's production; labor shortage in the Middle West decreased the production in that field. The curtailment was mainly involuntary, but has probably had a lot to do with the improved lead market.

Although some observers were inclined to think that lead consumption by battery manufacturers would decline in the fall, the demand from this class of consumers will likely continue to be good. Cable manufacturers report a slowing up of business, and the paint industry is only fair. Stocks in the hands of producers are small and often when a particular brand is requested the producer has been unable to fill the inquiry. In the New York market several hundred tons of lead were sold to net as high as 6.65c. Chemical lead in St. Louis is almost unobtainable; desilverized is scarce. Considering the manner in which the London market has been advancing, it would not be surprising to see the domestic market making a bid for some of the Mexican lead now going to European consumers. Mexican lead mines have been prospering in the lead market.

Zinc

Foreign demand for zinc has finally come to the aid of the zinc market. It had been anticipated for many weeks, but it was not until last week that sales began to be made. It is estimated that over 8,000 tons have been sold, with a demand for good-sized tonnages still existant. The price of zinc in East St. Louis advanced from 6.35c. per lb. to 6.50c., the general holding level today. The tendency is still upward. At least one producer has been out of the market owing to labor troubles at his plant, but this difficulty is being smoothed out and should not be a market factor for long. Inquiry from domestic consumers has been fair. Galvanizers show a disposition to ask that shipments be postponed in some cases; at other times they urge prompt shipment. Ore production in the Middle Western fields is increasing again. The price of high-grade metal continues at 8 to 8½c. per lb.

Tin

Although the price of tin has advanced in London, and consequently in New York, consumers remain uninterested, and buying has been light.

The weekly average price of Straits tin should have been given at 38.725 instead of 39.725 last week.

Arrivals of tin, in long tons: Aug. 15th, Straits, 170; 16th, Straits, 125; China, 75; 20th, Rotterdam, 25; Straits, 850; 21st, Java, 50; Liverpool, 100; total so far in August, 4,720.

Foreign Exchange

European exchanges appear somewhat improved over last week. On Tuesday, Aug. 22, cable quotation on francs were 5.68c., and lire, 4.33c. Canadian dollars were quoted at 2 7/64 per cent discount.

Silver

The market has been dull, with only moderate inquiry from the Indian bazaars and China. This demand was not sufficient to maintain the recent price level in London,

Mexican Dollars—Aug. 16th, 48⅛; 17th, 48; 18th, 48; 20th, 48; 21st, 48; 22d, 48⅞.

Other Metals

Quotations cover large wholesale lots unless otherwise specified.

Aluminum—99 per cent grade, 26@27c. per lb.; 98 per cent, 25@26c. London, £115.

Antimony — **Chinese and Japanese** brands, 7¾c. W.C.C. brand, 8½c. Cookson's "C" grade, 10@10.50c.

Bismuth—$2.55 per lb. London, 10s.

Cadmium—$1 per lb. London, 4s. 6d.

Cobalt—$3 per lb. for spot.

Iridium—$275@$300 per oz.

Nickel—27@32c. per lb. for 99 per cent virgin metal. London, £130 per long ton.

Palladium—$80 per oz.

Platinum—$116 per oz. London, £24 15s.@£25.

Quicksilver — $65 per 75-lb. flask. Quiet. San Francisco wires $64.00. London, £9 5s.

The prices of **Magnesium, Molybdenum, Monel Metal, Osmium, Radium, Rhodium, Selenium, Tellurium, Thallium,** and **Tungsten** are unchanged from prices given Aug. 4.

Metallic Ores

Chrome, Iron Ore, Magnetite, Manganese, Molybdenum, Titanium, Tungsten, Vanadium, and **Zircon Ore** are unchanged from the quotations published Aug. 4.

Zinc and Lead Ore Markets

Joplin, Mo., Aug. 18.—Blende, per ton, high, $42.10; basis 60 per cent zinc, premium, $40; Prime Western, $38.50@$39; fines and slimes, $36@$34; average settling price, all blende, $37.10.

Lead, high, $82.25; basis 80 per cent lead, $80; average settling price, all lead ores, $78.40 per ton.

Shipments for the week: Blende, 11,832; lead, 913 tons. Value, all ores the week, $509,510.

From 40 to 50 per cent of the lead being produced has been withheld from the market for several weeks. Offerings this week of $80 brought some of it onto the market. Blende prices reached $40 basis this week for lead-free ore, with a strong market for all other ores at $38.50 to $39 per ton. For the first time producers have held down production by concerted action over a month's period of time, and it is still being held around 5,000 tons below the peak of last April, when it reached 15,000 tons per week. The five and one-half day week is causing the reduction in part, with some large mines closed altogether.

Platteville, Wis., Aug. 18.—Blende, basis 60 per cent zinc, $41.50 per ton. Lead, basis 80 per cent lead, $80 per ton. Shipments for the week: Blende, 484 tons; lead, 9 tons. Shipments for year: Blende, 20,272; lead, 500 tons. Shipments for the week to separating plants, 926 tons blende.

Non-Metallic Minerals

Asbestos—Crude No. 1, $375@$500; No. 2, $225@$325; spinning fibers, $150@$225; magnesia and compressed sheet fibers, $100@$150; shingle stock, $55@$60; paper stock, $35@$45; cement stock $20@$25; floats, $9@$12. All f.o.b. mines, per short ton, Quebec.

Barytes, Bauxite, Borax, Chalk, China Clay, Diatomaceous Earth, Emery, Feldspar, Fluorspar, Fuller's Earth, Graphite, Gypsum, Limestone, Magnesite, Manjak, Mica, Monazite, Phosphate, Pumice, Pyrites, Silica, Sulphur, Talc and Tripoli are unchanged from the Aug. 4 prices.

Mineral Products

Arsenious Oxide (white arsenic)—10c. per lb., delivered over the balance of the year. Inquiry beginning.

Copper Sulphate—5.10@5.25c. per lb., domestic product.

Sodium Nitrate—$2.45 per 100 lb., ex vessel, Atlantic ports.

Potassium Sulphate and Sodium Sulphate are unchanged from quotations of Aug. 4.

Ferro-Alloys

Ferrosilicon—50 per cent, $85.

Ferrotungsten—88@95c. per lb. of contained W, f.o.b. works.

Ferrocerium, Ferrochrome, Ferromanganese, Ferromolybdenum, Ferrotitanium, Ferro-uranium and **Ferrovanadium** are unchanged from the prices published Aug. 4.

Metal Products

Copper—Sheets, 22.75c. base; wire, 16.75c.

Nickel Silver—18 per cent Grade A sheets, 28.75c.

Yellow Metal — Dimension sheets, 20c.; rods, 17c.

Zinc Sheets—Base price, $9.25 per 100 lb., f.o.b. plant.

Lead Sheets are unchanged from the prices given in the Aug. 4 issue.

Refractories

Bauxite Brick, Chrome Brick, Firebrick, Magnesite Brick, Magnesite Cement, Silica Brick and **Zirkite** are unchanged from the Aug. 4 prices.

The Iron Trade

Pittsburgh, Aug. 21, 1923

Considered from the broad viewpoint, the whole iron and steel market has improved in tone and sentiment.

All finished steel products can be bought for early shipment at the regular prices, except tin plate, which is sold out for the quarter.

A fresh revival in railroad buying is expected soon. Already railroads are being offered later deliveries of rails, on 1924 orders, than they are asking for. There are still large car and rail orders to be completed.

Pig Iron—Sales of basic iron at the full price of $25, Valley, to which the market declined the first week of July, make an impressive showing of price stability in pig iron. Bessemer remains at $26.50 and foundry at $25 to $26.

Connellsville Coke—The market has stiffened farther, with prompt at $4.50 @$4.75 for furnace and $5.25@$5.75 for foundry.

COMPANY REPORTS

Chino Copper Co.

Copper; Hurley, New Mexico

A statement of the operations of the Chino Copper Co., for the second quarter of the calendar and fiscal year ended June 30, 1923, states that four regular sections of the mill at Hurley, out of seven to be reconstructed, together with a proportionate number of ball mills in the fine-grinding section, were in operation during the quarter. Conditions of operation and progress in making betterments did not improve during the quarter as rapidly as expected, owing to the fact that the skilled labor situation has remained unsatisfactory. But, regardless of this, substantial advances in these directions were made and are continuing in a way which promises much improvement in results in the near-by future.

The total amount of ore treated for the quarter was 712,260 dry tons, an average of 7,827 tons per day, the average grade being 1.41 per cent copper. The comparative figures for the preceding quarter were 7,825 tons per day, and an average of 1.51 per cent copper. The average gross recovery of copper contained in the concentrates was 17.82 lb. per ton of ore treated, compared to 19.72 lb. per ton for the previous quarter.

In addition to the copper produced from mill operations, there were shipments of crude ore and precipitates from the mine.

The net production of refined copper from all sources, after allowing for smelter deductions, was 12,416,022 lb., as stated below, compared to 13,356,764 lb. for the preceding quarter:

Second Quarter, 1923		First Quarter, 1923	
April	3,880,694	January	4,440,237
May	4,539,540	February	3,768,330
June	3,995,788	March	5,148,197
Total	12,416,022		13,356,764
Average monthly production	4,138,674		4,452,255

The cost per pound of net copper produced from all sources was 13.95c., compared with 12.50c. for the quarter ended March 31, 1923. These costs include all operating charges and general charges of every kind except depreciation and reserves for federal taxes, and also include credit for gold and silver values and miscellaneous revenues. The increase in cost was due in large measure to the lower grade of ore treated, but more particularly to operating interferences occasioned through the installation of improved apparatus and changes in milling methods.

The following tabulation shows the financial results of operations exclusive of depreciation or federal tax charges:

	Second Quarter, 1923	First Quarter, 1923
Operating gain	$201,698.24	$388,752.46
Miscellaneous income, including precious metals	53,378.95	16,859.38
Operating gain for quarter	$255,077.19	$405,611.84

The above figures are based on an average of 16.006c. per lb. for copper, compared with 15.44c. for the quarter ended March 31, 1923.

At the mines there was removed by the twelve steam-shovel crews a total of 981,930 cu.yd. of ore and capping, compared to a total of 824,453 cu.yd. for the first quarter of 1923. Of the total material removed, 474,527 cu.yd. was capping, the remainder being equal to 868,448 tons of ore, of an average grade of 1.33 per cent copper. The difference between the tons of ore mined and tons of ore milled is accounted for by low-grade oxidized ore sent to the ore piles.

Barnes-King Development Co.

Gold, Silver; Montana

The records of the Barnes-King Development Co. show the following operating results for the quarter ending June 30, 1923:

Earnings		
Shannon property	$6,229.36	
Interest	524.79	
		$6,754.15
Deduct		
North Moccasin property expense less profit on buildings sold	$1,113.26	
Piegan-Gloster property expense	1,004.26	
Kendall property expense less power plant lighting	696.67	
Miscellaneous	3,473.57	
		6,287.76
Difference being profit on operations for quarter ending June 30, 1923		$466.39

The above figures include provisions for depreciation on the various plants of the company on the same basis as has been used heretofore.

During the quarter, 2,478 tons of ore were shipped to the Gloster mill, with a bullion value of $38,145.13, or $15.39 per ton.

As mentioned in the previous quarterly report, the above tonnage came from the pillars about the shaft and was of much better grade than the ore coming from the lower levels.

Removal of rails and equipment was completed up to the 400 level, or 200 ft. below the adit level.

From the proportion of pillar tonnage already removed, it seems probable that the balance will require at least all of the third quarter to remove.

On the Whittley prospect in Barton Gulch, Madison County, Mont., No. 2 tunnel was advanced 114 ft. without finding pay ore.

An option was obtained on a property 14 miles northwest of Butte, but nothing of interest yet developed.

Nothing was done at the oil property at Winifred.

Utah Copper Co.

A statement of the affairs of the Utah Copper Co., for the second quarter of the fiscal and calendar year 1923, states that the total net production of copper from all sources was 47,646,423 lb., compared with the previous quarter's output of 33,103,190 lb., as shown in the following statement of production, by months, for the respective periods:

Second Quarter, 1923	Pounds	First Quarter, 1923	Pounds
April	14,162,164	January	11,214,785
May	16,547,445	February	9,760,544
June	16,936,814	March	12,127,861
Total	47,646,423		33,103,190
Average monthly production	15,882,141		11,034,397

During the quarter the Arthur plant treated 1,614,300 dry tons of ore and the Magna plant 1,009,400 dry tons, a total for both plants of 2,623,700 dry tons, or an increase of 849,000 tons compared with the previous quarter.

The average grade of ore treated at the mills was 1.15 per cent copper, and the average mill recovery of copper in the form of concentrates was 82 per cent of that contained in the ore, compared with 1.17 per cent and 83 per cent, respectively, for the previous quarter.

The average cost per net pound of copper produced, including all fixed and general charges except depreciation and Federal tax reserves and after crediting gold and silver

and miscellaneous earnings of the quarter, was 8.077c., as compared with 8.825c. for the preceding quarter. The value of gold and silver recovered and the miscellaneous earnings amounted to 1.266c. per lb. of copper, this excluding the amount of the railway dividend received, which is not applied as a credit in reduction of operating costs.

The following tabulation shows the financial results of the company's operations for the quarter, as compared with the previous quarter:

	Second Quarter, 1923	First Quarter, 1923
Net profit from copper production	$2,553,633.66	$1,797,521.47
Miscellaneous income, including gold and silver	603,355.03	443,590.20
Bingham & Garfield Ry. Co. dividend	200,000.00	.....
Total income	$3,356,988.69	$2,241,111.67

Earnings for the second quarter are computed on the basis of 14.723c. per lb. for copper.

A quarterly distribution to stockholders of $1 per share was made on June 30, 1923, and amounted to $1,624,490.

The total capping removed during the quarter was 638,221 cu.yd., compared with 505,986 cu.yd. for the previous quarter.

The ore-delivery department transported a total of 2,796,859 tons of ore, being an average of 30,734 tons per diem, compared with 1,945,668 tons and 21,619 tons respectively, for the previous quarter.

The Bingham & Garfield Ry. Co. transported a total of 355,337 tons of freight, or an average of 3,904 tons per diem.

Nevada Consolidated Copper Co.

A statement of the outcome of operations of Nevada Consolidated Copper Co. for the second quarter of the fiscal and calendar year 1923 follows:

Production of copper for the quarter was 14,803,329 lb., compared with 11,780,815 lb. for the preceding quarterly period. The following tables show the net production, by months, for the current quarter and the preceding quarter:

Second Quarter, 1923	Pounds	First Quarter, 1923	Pounds
April	4,492,031	January	3,795,340
May	5,052,379	February	3,730,692
June	5,258,919	March	4,254,783
Total	14,803,329		11,780,815
Average monthly production	4,934,443		3,926,938

A total of 608,183 tons, dry weight, of Nevada Consolidated ore, averaging 1.36 per cent copper, was milled, and 18,105 dry tons of Ruth mine direct-smelting ore, averaging 6.48 per cent copper, was shipped to the smelter. Besides the company ores received, 49,103 tons of custom ores was milled and the concentrates product thereof were smelted. An additional tonnage of custom ore—6,060 tons of direct-smelting ore—was also received at the smelter.

The cost of production, including all fixed and general charges, except depreciation, and after crediting gold and silver values and all miscellaneous earnings incident to the quarter, was 10.78c. per lb. of copper produced, as compared with 11.03c. for the preceding quarter. The amount of the railway dividend received is not included in the miscellaneous earnings applied in reduction of costs.

The financial outcome of operations, based upon an average carrying price of 15.261c. per lb. of copper, is shown in the summary statement submitted below:

	Second Quarter, 1923	First Quarter, 1923
Operating gain from production of copper	$510,552.18	$446,929.26
Value gold and silver and miscellaneous earnings	152,483.73	97,293.48
Nevada Northern Ry. dividend	300,000.00	
Total income for quarter	$963,035.91	$544,222.62

Reconstruction of the concentrator has progressed satisfactorily. Two units of the mill, out of three under consideration, have been practically completed, thus restoring a normal capacity of approximately 9,500 tons per day. Construction of the third unit, which will complete the restoration of the concentrator to a capacity in excess of that destroyed by fire, is proceeding somewhat slowly. This is due to a scarcity of construction employees, and it is not believed that this additional capacity will be available for use until some time during the fourth quarter.

Iron Cap Copper Co.

Copper; Globe, Arizona

A report of the operations of the Iron Cap Copper Co. states that during the second quarter of 1923 the production was 1,540,179 lb. of copper, 18,132 oz. of silver, and 181 oz. of gold. Following is a statement of the company's financial operations for the period covered by the report:

Income for the quarter	$196,608.06
Expenses for the quarter	168,856.69
Profit	$27,751.37

There has been only a slight difference in the monthly rate of production, and the decline in earnings from those of the last quarter is because of the lower prices for copper and silver, coupled with a higher wage rate.

Transvaal Gold Output Practically Unchanged

The gold production of Transvaal mines continues normal, the figure for June being 755,309 oz. The record for the last three years follows:

Transvaal Gold Production, 1920-1923

In Fine Ounces

	1920	1921	1922	1923
Jan.	670,503	651,593	639,728	764,469
Feb.	625,330	558,137		704,970
March	707,036	671,123		761,586
April	686,979	681,382	511,338	743,651
May	699,041	687,776	629,786	786,564
June	715,957	678,490	675,697	755,309
July	736,099	689,555	730,635	.....
Aug.	702,083	711,526	752,490	.....
Sept.	682,173	691,026	747,089	.....
Oct.	662,472	707,825	778,159	.....
Nov.	633,737	704,236	764,476	.....
Dec.	632,215	681,847	790,712	.....
Totals	8,153,625	8,114,516	7,020,111	4,516,549

The total for 1917 was 9,018,084 oz.; for 1918, 8,418,292 oz.; and for 1919, 8,330,091 oz.

Production and Dividends of Prominent Gold Mines

By W. D. Pagan

I recently had occasion to prepare a statement of the operations of the North Star Mines Co. during the last twenty years, which showed that during that period the production of the North Star mine had amounted to $19,925,542, of which 25.75 per cent, or $5,130,684, was distributed in dividends. It occurred to me that it would be interesting to compare these results with those at a number of other representative gold mines, and I have obtained corresponding figures as to the Dome, Homestake, Oriental Consolidated, Portland, and Tomboy mines. The comparative figures showing the production and dividends of the companies operating these properties are set forth in the accompanying statement.

The operating profit of the North Star and probably the other companies was considerably in excess of the amount distributed in dividends; but over a period of years the amount actually returned to stockholders may be taken as a fair measure of the profit realized.

Production of and Dividends Paid by Various Gold-mining Companies During a Period of Years to the End of 1922

Company	Location	Period, Years	Production	Dividends Total	Dividends Per Cent of Production
Dome (a)	Ontario	10	$14,814,821	$3,110,834	21.00
Homestake	South Dakota	20	112,528,556	25,647,157	22.69
North Star	California	20	19,925,542	5,130,684	25.75
Oriental Consolidated	Korea	20	35,431,915(b)	8,797,425	24.83
Portland	Colorado	29	54,272,883	11,692,080	21.54
Tomboy	Colorado	23	20,495,203	3,998,790(c)	19.51

(a) Mill closed down during 1919 and four months of 1918.
(b) Stated in annual report as "assay value" of the ore.
(c) £849,000 at $4.71.

Currency Disorganization Affects German Metal Markets

SPECIAL FOREIGN CORRESPONDENCE

The month of July brought with it a further fivefold depreciation of the German national currency. In order to save it from final dissolution, the authorities passed a series of legislative measures under which the prohibition of dealing in terms of foreign currency in internal commerce and of future bargaining was paramount. This enactment dealt a heavy blow to the metal business, the more so as, initially, domestic and foreign official exchange quotations showed wide discrepancies and nobody was inclined to sell metals on the basis of the "sanctioned" exchange rates of the mark. The Berlin and Hamburg Metal Exchanges had to cease their operations, to resume them after a prolonged exchange of opinions with the German government. The latter eventually gave way by allowing quotations to be made upon the basis of the world market prices, for the lack of official markets had proved fatal to the consuming community, because the so-called "black," illegal exchanges began to display much usury by computing "blackback" (i.e. fancy dollar, contrary to "greenback") prices which consumers in need of metals were compelled to pay.

The special structure of the German metal markets, with their hedging and covering operations and their close connection with the London Exchange, renders bargaining by foreign bills an absolute necessity. Exporting circles could therefore carry through their wishes, and the "Reichswirtschafts" ministry put the entire exchange legislation out of force, in the third part of the month, for the "first importers." It remains to be seen whether the compass of German metal business will widen now. So far it must be emphasized that the legal entanglements reported above have brought with them a very low record of business and experts compute the amount of copper ordered in July at around 3,000 metric tons, only comparable to the amounts in the months immediately following the end of the Great War. A heavy drain on stocks in storage yards has been in the meantime effected by the big consuming concerns and the reserve of copper in the whole of Germany does not surpass now 8,000 tons or thereabouts, while the activity of the German refineries has much lessened on account of the practical disappearance of Italian and Swedish metal scrap.

The monetary deficit of the Federal Railways compels them to limit repair and new construction orders to the utmost, with the result that scrap reserves from this origin are also dwindling away from day to day. German cathodes, which some months ago were being freely offered in foreign countries below American parity, are now somewhat of a drug even in the interior of the country, and lead—especially Perth Amboy and some Spanish or Australian brands—has to be imported instead of German secondary lead ["Berliner" or "Raffinadeblei"], for the producers of the latter are not able to cover the large requirements of the multitude of users. The bulk of the present German lead production may still be put at around 55,000 metric tons a year, whereas at least twice this sum is actually required. Therefrom the paradox arose in the month under review that German-made lead, even secondary material, was dearer than foreign. The same fact may be stated for other lines, except zinc, of which large lots were contracted by the United Kingdom from the Zinc Syndicate of Kattowitz. The Giesche mining concern, which partly used to sell Breslau, declined, in general, to sell in terms of marks and made sterling counter value a condition.

The rapid debasement of the German money as against the relative standstill of the Polish mark has reversed the zinc situation in Germany, for the mine workers in Upper Silesia have to be paid in other than German currency, whereas mine wood must be acquired by Polish, Lithuanian or Scandinavian money. As for the general outlook, it is to be held in view that the amount of business in Germany is likely to diminish further under the present conditions, because the disinclination to get rid of foreign means of payment against metals is common with the trading circles.

Facts for the Stockholder

XXVI—Ontario Silver Mining Co.

The Ontario Silver Mining Co. was incorporated in California, in December, 1876. It owns 800 acres of patented mineral ground at the head of Little Cottonwood Canyon, and other properties in Summit and Wasatch counties, Utah, including the Ontario mine, a famous old silver-lead property developed by about 60 miles of old workings, including two tunnels and a 2,000-ft. shaft.

The company also owns a four-sevenths interest in the Weber Coal Co., with 811 acres of coal lands, one-third interest in the Naildriver Mining Co., one-third in the Silver Lake Water Co., and 75,000 shares of the capital stock of the New Quincy Mining Co.

During recent years much of the work in the upper levels of the mine has been done under a leasing system. In 1915, workings blow the 1,500 level, or drain tunnel No. 2 level, were reopened, and considerable repair work and development was done on company account. During 1919, several small orebodies were opened between the 1,500 and 1,800 levels, and in 1920, the 2,000 level was unwatered after twenty years' flooding. New development work in 1919 aggregated 3,311 ft., and in 1920, 5,087 ft.

The formations found in the Ontario mine, in descending order, are designated as the Ontario quartzite and the Wasatch limestone, between which is a transition formation about 200 ft. thick. In the west end of the mine all the orebodies of consequence have been found in the quartzite and transition formations. In the Wasatch limestone the orebodies are small and decrease in value rapidly the deeper they extend into the lime. The ore shows an increase in zinc content with depth.

At one time the Ontario mine was the largest silver producer in Utah, and its total production is estimated at over $35,000,000. The value of ore sales during recent years has been as follows: $265,215 in 1916, $315,159 in 1917, $561,768 in 1918, $284,379 in 1919, $551,369 in 1920, $208,984 in 1921, $293,621 in 1922. Other income consisted of rents and royalties averaging around $11,500 per annum for the six years ended with 1921, and $19,259 in 1922. Interest and dividends on investments has ranged between $20,000 and $30,000 per annum during the last six years.

Net operating results during the last seven years have been as follows: Deficit of $954 in 1916, profit $64,679 in 1917, profit $328,374 in 1918, deficit $14,217 in 1919, profit $158,326 in 1920, deficit $88,661 in 1921 and $58,680 in 1922.

Two dividends of $75,000—$150,000 for the year—were distributed in 1918, and one of $75,000 in 1919, the latter being paid out of 1918 profits. The loss in 1919 was owing to lower grade of ore, higher costs of mining, smelter charges and freight, and to interruption of operations during a labor strike.

During 1922, the greater part of the development work was performed in the section east of the Ontario fault. This section of the company's ground is entirely unexplored, and the plan of development now being carried out is in accordance with the advice of its consulting engineers and geologists.

The 1,100 level has been driven easterly along the vein east of the fault a distance of 603 ft., of which 400 ft. has been in low-grade ore, containing streaks and bunches of high-grade. However, not enough high-grade ore is present to make mining profitable. On the 1,200 level, 1,073 ft. of drifting and 150 ft. of raising has been done. Of this work, 600 ft. of drifting and 120 ft. of raising has been in low-grade ore, and 30 ft. of raising in shipping ore. Early in 1923, a promising orebody was opened on the 600 level east of the fault.

Capital stock consists of 150,000 shares, par value $100. There is no funded debt.

Price range of shares on the New York Stock Exchange has been: High, 13 in 1918; low, 3 in July, 1923; closing quotation 3½ bid, 5 asked, Aug. 20, 1923.

INVESTIGATOR

MINING STOCKS

Week Ended August 18, 1923

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Ahmeek	Boston	59½	58½	59½	June 23, Q	$1.50
Alaska-Br. Col.	N. Y. Curb	1½	1	1½		
Alluez	Boston	*17	*15½	*16½	Mar. '19	1.00
Anaconda	New York	41	38½	41	Je. 16, Jy. 23	0.75
Arcadian Consol.	Boston	2	1½	1½		
Ariz. Com'l.	Boston	9⅜	9⅛	9⅛	July '23,	0.50
Calaveras	N. Y. Curb			2		
Calumet & Arizona	Boston	49	47	49	June '23,	1.00
Cal. & Hecla (New)	Boston	41½	40½	41	June '23, Q	10.00
Centennial	Boston	8	8	8	Dec. '18, SA	1.00
Cerro de Pasco	New York	40	38½	40	Jy. 19, Au. 1	1.00
Chile Copper	New York	26⅛	25⅛	26	Se. 1, Se. 29, Q	0.62½
Chino	New York	17⅜	16⅜	17	Sept. '20, Q	0.37½
Con. Coppermines	N. Y. Curb	2	1 1/16	1⅞		
Copper Range	Boston	28	27½	28	May '23, Q	1.00
Crystal Copper	Boston Curb	*57	*62	*60		
Davis-Daly	Boston	2½	2½	2½	Mar. '20, Q	0.25
East Butte	Boston	6	5⅜	6	Dec. '19, A	0.50
First National	Boston Curb	35	35	35	Feb. '19, SA	0.15
Franklin	Boston	1 1/16	1 1/16	1 1/16		
Gadsden Copper	Boston Curb	55	55	55		
Granby Consol.	New York	18⅛	17⅜	18⅛	May '19, Q	1.25
Greene-Cananea	New York	17	16⅛	17	Nov. '20, Q	0.50
Hancock	Boston			3		
Howe Sound	N. Y. Curb	3⅛	3⅛	3⅛	Jy. 2, Jy. 16	0.05
Inspiration Consol.	New York	29	28	29	Je.14, Jy. 2 Q	0.50
Iron Cap	Boston Curb	4½	4	4½	May 23, K	0.15
Isle Royale	Boston	21	21	21	June '23, Q	0.50
Kennecott	New York	34⅜	33⅛	34⅜	Je. 8, Jy. 2 Q	0.75
Keweenaw	Boston	80	80	80		
Lake Copper	Boston	2	2	2		
Magma Copper	New York	29⅛	28⅜	29⅛	Jan. '19, Q	0.50
Mason Valley	N. Y. Curb	1⅛	1⅛	1⅛		
Mass Consolidated	Boston	1⅜	1⅛	1⅛	Nov. '17, Q	1.00
Miami Copper	New York	24⅛	23⅞	24⅛	Au. 1, Au. 15, Q	0.50
Michigan	Boston	1 1/16	1 1/16	1 1/16		
Mohawk	Boston	41⅛	40⅛	41	June '23, Q	1.00
Mother Lode Coa.	New York	9⅛	9⅛	9⅛	Je. 8, Je. 30, Q	0.50
Nevada Consol.	New York	11⅛	11⅛	11⅛	Sept. '20, Q	0.25
New Cornelia	Boston	17⅞	17⅛	17⅞	Au. 3, Au, 20, Q	0.25
North Butte	Boston	2½	2½	2½	Oct. '18, Q	0.25
Ohio Copper	N. Y. Curb	*67	*62	*65		
Old Dominion	Boston	17	17	17	Dec. '18, Q	1.00
Osceola	Boston	31½	30½	31	June '23, Q	1.00
Phelps Dodge	Open Mar.	†150	†160		Je. 20, Jy. 2 Q	1.00
Quincy	Boston	26½	25	26½	Mar. '20, Q	1.00
Ray Consolidated	New York	10⅜	10	10⅜	Dec. '20, Q	0.25
Ray Hercules	N. Y. Curb	*90	*75	*90		
St. Mary's Min. Ld.	Boston	32½	31½	32½	Mar. '23, K	3.00
Seneca Copper	New York	7½	7½	7½		
Shannon	Boston	*55	*50	*55	Nov. '17, Q	0.25
Shattuck Arizona	New York	7	6⅜	7	Jan. '20, Q	0.25
South Lake	Boston			*98		
Superior & Boston	Boston	1	*98	1		
Tenn. C. & C. cfs.	New York	9⅛	8⅜	9⅛	Je. 30, Jy. 16, Q	0.25
Tuolumne	Boston			*14½	May '13,	0.10
United Verde Ex.	N. Y. Curb	29⅛	28⅜	29⅛	Jy. 5, Au. 7, Q	1.00
Utah Consol.	Boston			1½	Sept '18,	0.25
Utah Copper	New York	59⅜	58⅛	59⅜	Je. 8, Je. 30, Q	1.00
Utah Metal & T.	Boston	*58	*55	*58	Dec. '17,	0.30
Victoria	Boston	*87	*87	*87		
Winona	Boston	*65	*65	*65		
Wolverine	Boston	7	6	6½		
NICKEL-COPPER						
Internat. Nickel	New York	13⅛	11⅛	13	Mar.' 19,	0.50
Internat. Nickel pfd.	New York	78⅛	78⅛	78⅛	Jy. 19, Au. 1	1.50
LEAD						
Carnegie Lead & Zinc	Pittsburgh			3⅞		
National Lead	New York	116⅛	112⅛	116⅛	Se.16, Se.29 Q	2.00
National Lead pfd.	New York			111⅛	Au. 24, Se.15 Q	1.75
St. Joseph Lead	New York	18⅛	17⅛	18⅛	Se.9, Se.20 Q, X	0.50
ZINC						
Am. Z. L. & S.	New York	9	8⅛	9	May '20,	1.00
Am. Z. L. & S. pfd.	New York			31	Nov. '20, Q	1.50
Butte C. & Z.	New York	6	5⅜	6	Mar. '23,	0.50
Butte & Superior	New York	17⅛	13⅜	16⅛	Je. 15, Je. 30, Q	0.50
Callahan Zn-Ld.	New York	5⅜	5⅛	5⅜	Dec. '20, Q	0.50
New Jersey Zn.	N. Y. Curb	150	149⅞	150	Jy.31, Au.10 Q	2.00
United Zinc	N. Y. Curb			*80		
Yellow Pine	Los Angeles			*60	June '23, Q	0.03
SILVER						
Alvarado	N. Y. Curb	3	2	2½		
Batopilas Mining	New York	⅛	⅛	⅛	Dec. '07, I	0.12½
Beaver Consol.	Toronto	*33¾	*30	*30¾	May '20, K	0.03
Candelaria	N. Y. Curb	*5	*5	*5		
Castle-Trethewey	Toronto	*25	*24½	*25		
Coniagas	Toronto	2.45	2.29	2.40	May '21, Q	0.12½
Crown Reserve	Toronto	*50	*50	*50	Jan. '17,	0.05
Hilltop-Nev.	N. Y. Curb.	*15	*12	*13		
Kerr Lake	N. Y. Curb	2½	2½	2½	Jy. 2, Jy. 16, Q	0.12½
La Rose	Toronto	*33	*31	*31	Apr. '22,	0.10
McKinley-Dar.-Sav.	Toronto	*16	*14	*14	Oct. '20, Q	0.03
Mining Corp. Can.	Toronto	2.50	2.40	2.40	Sept. '20, Q	0.12½
Nipissing	N. Y. Curb	5⅛	5⅛	5⅛	Jy. 1, Jy. 20 Q	0.15
Ontario Silver	New York			3⅛	Jan. '19, Q	0.50
Temiskaming	Toronto	*38	*37	*37	Jan. '20, K	0.04

Stock	Exch.	High	Low	Last		Last Div.
GOLD						
Alaska Gold	New York	⅛	⅛	⅛		
Alaska Juneau	New York	⅛	⅛	⅛		
Boundary Red M.	N. Y. Curb			*12		
Carson Hill	Boston	5⅛	5⅛	5⅛		
Cresson Consol. G.	N. Y. Curb	3⅛	3⅛	3⅛	July '23	2.00
Dome Mines	New York	35⅛	34	34⅛	Je.30, Jy.20 Q	1.00
Golden Cycle	Colo. Springs			1.05	Dec. '22, Q	0.02
Hollinger Consol.	Toronto	12.25	11.85	11.80	Se.15, Oc.5, M	0.05
Homestake Mining	New York	61½	61⅛	61⅛	Au.20, Au.25 M	0.50
Kirkland Lake	Toronto	*34	*34	*34		
Lake Shore	Toronto	3.45	3.28	3.28	Au.1 Au.15'23, Q	0.02
McIntyre-Porcupine	New York	16⅛	16⅛	16⅛	Au.1, Se.1, Q	0.25
Portland	Colo. Springs			*35	Oct. '20, Q	0.01
Teck-Hughes	N. Y. Curb	1⅛	98	1 1/16		
Tom Reed	Los Angeles	*48	*42	*48	Dec. '19,	0.02
United Eastern	N. Y. Curb	1⅛	1 1/16	1 1/16	Jy. '28, Q	0.15
Vipond Cons.	Toronto	*67	*63	*67		
Wright-Hargreaves	Toronto	3.10	3.10	3.10	Apr. '23,	0.02½
Yukon Gold	N. Y. Curb	1⅛	1⅛	1⅛	June '18,	0.02½
GOLD AND SILVER						
Boston-Mont. Corp.	N. Y. Curb	*13	*13	*13		
Con. Cortez	N. Y. Curb	*71	*67	*71		
Con. Virginia	San Francisco					
Continental Mines	N. Y. Curb	5	4⅞	5		
Dolores Esperanza	N. Y. Curb	1 1/16	*70	*71	Jy. 1, Jy. 10 Q	0.05
Jib Consol.	N. Y. Curb			*70		
Tonopah Belmont	N. Y. Curb	*68	*66	*68	Apr. '23, Q	0.05
Tonopah Divide	N. Y. Curb	*53	*50	*51	May 23	0.10
Tonopah Extension	N. Y. Curb	2 1/16	2	2 1/16	Se. 10, Oc. 1	0.05
Tonopah Mining	N. Y. Curb	1 1/16	1⅛	1 1/16	Apr. '23, Q	0.07½
Unity Gold	N. Y. Curb			3⅛		
West End Consol.	N. Y. Curb	*83	*81	*82	Mar. '23, Q	0.05
SILVER-LEAD						
Bingham Mines	Boston	16⅛	16⅛	16⅛	Sept. 19, Q	0.25
Cardiff M. & M.	Salt Lake	*50	*50	*50	Dec. '20,	0.15
Chief Consol.	Boston Curb	4	3⅛	3⅛	Au. 1, '23, Q	0.10
Columbus Rexall	Salt Lake	*40	*35½	*38	Aug. '22,	0.03
Consol. M. & S.	Montreal	27	25	26½	Oct. '20, Q	0.62½
Erupcion	Boston Curb	3	2⅞	3	Apr. '23, Q	0.125
Federal M. & S.	New York	10	8	10	Au 25, Se. 15	1.75
Federal M. & S. pfd.	New York	42½	37	42	June '23, Q	1.75
Florence Silver	Spokane	29	25½	25½	Apr. '19, Q, X	0.01½
Hecla Mining	N. Y. Curb	7⅛	7	7	Je. 15 Q	0.50
Iron Blossom Con.	N. Y. Curb	*23	*23	*23	July 16,	0.02½
Marsh Mines	N. Y. Curb			*7	June '21, I	0.02
Park City	Salt Lake			3.25	Je.15, Jy.2 Q	0.12½
Park Utah	N. Y. Curb	3	3	3	Je.15, Jy.2 Q	0.15
Prince Consol.	Salt Lake	*1⅛	*1	*1	Nov. '17,	0.02½
Silversmith	Spokane	*36	*35	*35	Jy. 2, Jy. 10	0.02
Simon Silver-Lead	N. Y. Curb	*15	*10	*15		
Snowstorm Silver-L.	N. Y. Curb			*43		
Tamarack-Custer	Spokane	1.20	1.18	1.20	Je.30, K	0.02
Tintic Standard	Salt Lake	2.90	2.87½	2.90	July '23	0.15
Utah-Apex	Boston	3⅛	3⅛	3⅛	June '23, Q, X	0.50
IRON						
Bethlehem Steel	New York	50⅜	46⅛	50⅜	Se. 1, Oc. 1 Q	1.25
Char. Iron	Detroit	¼	¼	¼		
Char. Iron pfd	Detroit			1⅜		
Colorado Fuel & Iron	New York	28⅛	26	28⅛	Au.10, Au.25 Q	2.00
Col. Fuel & Iron pfd.	New York			102	Feb.'23, Q	2.00
Gt. North'n Iron Ore	New York	29⅛	27⅛	29⅛	Apr. '23	1.00
Inland Steel	N. Y. Curb			46⅛	Au.15, Se.1'23 Q	0.62½
Mesabi Iron	N. Y. Curb			6⅜		
Replogle Steel	New York	12½	11	12½		
Republic I. & S.	New York	46⅜	43½	46	May '21	1.50
Republic I. S. pfd.	New York	91	91	91	Se.15, Oc.1 Q	3.75
Sloss-Sheffield S. & I.	New York	46½	43	46½	Feb. '21	1.50
Sloss-Shef. S.&I. pfd.	New York			78	Je. 22, Jy. 2 Q	1.75
U. S. Steel	New York	92⅛	87⅛	92⅛	Au.30, Se.29, Q	1.25
U. S. Steel pfd.	New York	117⅛	117	117⅛	Au.7, Au.30 Q	1.75
Virginia I. C. & C.	New York			52	Je.16, Jy. 2	2.00
Virginia I.C.&C.pfd.	New York			78¼	Je.16, Jy. 2	2.50
VANADIUM						
Vanadium Corp.	New York	33⅛	28⅛	33	Jan. '21, Q	1.00
ASBESTOS						
Asbestos Corp.	Montreal	50	50	50	Je.30, Jy.15 Q	1.50
Asbestos Corp. pfd.	Montreal			74½	Je.30, Jy.15 Q	1.75
SULPHUR						
Freeport Texas	New York	12⅛	11	12⅛	Nov. '19, Q	1.00
Texas Gulf	New York	57⅛	55½	57⅛	Se.1, Se.15 Q	1.50
PLATINUM						
So. Am. Gold & P.	N. Y. Curb	3⅛	3	3		
MINING, SMELTING AND REFINING						
Amer. Metal	New York	45⅛	44	44⅛	Au. 20, Se. 1	0.75
Amer. Metal pfd.	New York			110	Au. 18, Se 1	1.75
Amer. Sm. & Ref.	New York	59⅜	55⅛	59⅜	Jy. 9, Au. 1	1.25
Amer. Sm.& Ref. pfd	New York	95⅛	95⅛	95⅛	Au.10, Se.1 Q	1.75
U. S. Sm. R. & M.	New York	24⅜	23⅛	24⅛	Jan. '21, Q	0.50
U.S. Sm.R.& M. pfd.	New York			42⅞	Jy.6, Jy.14 Q	0.87½

*Cents per share. †Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra.

Toronto quotations courtesy Arthur E. Moysey; Spokane, Pohlman Investment Co.; Salt Lake, Stock and Mining Exchange; Los Angeles, Chamber of Mines and Oil; Colorado Springs, Colorado Springs Stock Exchange.

NEW MACHINERY AND INVENTIONS

Kraut Flotation Machine

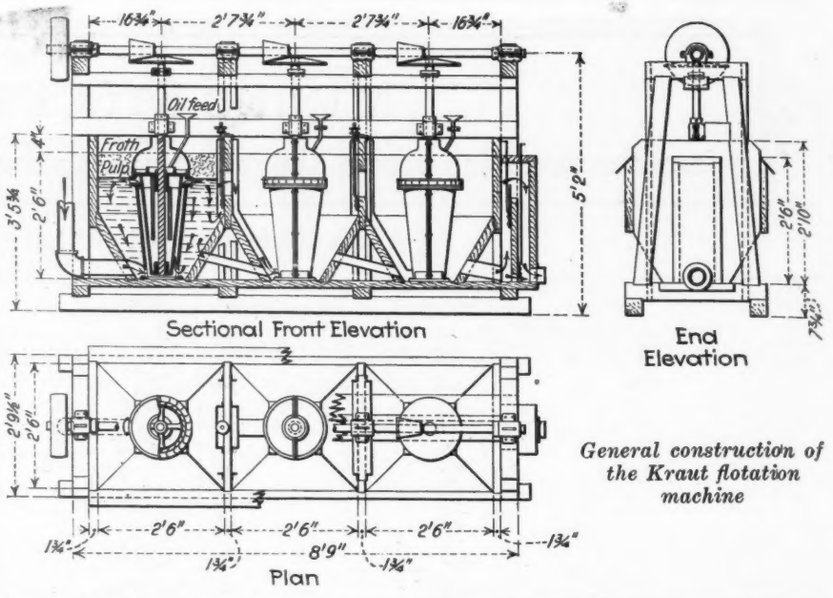
The Kraut flotation machine was designed with the object of providing an apparatus occupying small floor space, with large capacity, using a minimum of power per ton of ore treated, a reduced consumption of oil or other flotation reagent, combined with thorough aëration without unnecessary agitation of the pulp. According to Max Kraut, who says that the Southwestern Engineering Co., of Los Angeles, Calif., is considering acquiring the patent rights and placing the machine on the market, the machine consists of a hollow truncated cone, the large diameter on top, which is made to rotate about a vertically disposed shaft within a similarly shaped conical shell and spaced therefrom, all immersed in a tank, as shown in the accompanying illustrations. The surface of the hollow truncated cone is provided with helical grooves, and perforations through its wall communicate its interior with the interspace between the cone and the outer shell. The outer shell is provided at the bottom with several pulp inlet apertures, and at its upper end with a circular deflector ring, the curved blades of which are in close contact with the surface of the inner revolving cone. The outer shell and deflector ring are topped by a hood or cap through which passes the vertical shaft. The top surface of the hollow cone is provided with a circular groove, from which pass several pipes to the interior of the cone, thus establishing communication of its interior with the atmosphere.

In operation the pulp enters through a pipe at one of the apertures at the bottom of the outer shell, is picked up by the rotating cone, rises rapidly in a helical path upward, is deflected by the blades of the deflector ring, and is discharged in a concentric layer on or near the surface of the pulp level in the frothing tank. Due to the difference of diameter of top and bottom of the cone, the pulp is made to move at a far greater peripheral speed at the top than at the bottom. This causes the internal pressure of the pulp near the bottom to be greater than at the top and thus causes the upward motion of the pulp in the interspace between cone and shell. This upward motion is materially enhanced by helical grooves which are provided on the surface of the cone.

Simultaneously, as the volume of the interspace per unit of length increases with the height, the pulp is made to expand into this increasing volume, thereby tending to create a vacuum. This is transmitted to the interior of the cone through holes in its wall. The interior of the cone being in communication with the atmosphere by means of pipes as shown, air is drawn in through these pipes into the interior of the cone and thence into the interspace between cone and shell, and into the circulating pulp. The flotation reagent is fed onto the circular groove on top of the cone and drawn in through the pipes to its interior. This action atomizes the oil or other reagent and mixes it thoroughly with the air before the mixed vapor is drawn into the interspace and introduced into the pulp. The thoroughly aërated and oiled pulp discharges on the surface of the pulp level, where the mineral froth forms, builds up, and discharges on both sides of the machine. The tank has a relatively large surface for the building up of the froth, and converges rapidly toward the bottom to prevent accumulation of sand.

Any number of such cells as described can be placed in series, all driven from the same shaft. The cells are so arranged that the overflow from one to the next in series passes directly to the intake aperture of the outer shell. This arrangement makes short-circuiting of the pulp impossible and also permits the adjustment of pulp level and oiling in each cell independently of the other cells, if desired.

The machine is flexible and suitable for the treatment of the most difficult ores adapted for flotation. The low oil consumption makes differential or selective flotation more ready of accomplishment, and its exceedingly low power consumption (0.02 to 0.04 hp. per day per ton) provides for greatest economy in operation.



General construction of the Kraut flotation machine

The Diamond Drill Carbon Co., 53-63 Park Row, New York, has opened an office in the General Motors Building, 3044 West Grand Boulevard, Room 13-253, Detroit, Mich. Thomas S. Foley will be in charge, and will carry a complete stock of industrial diamonds and diamond-pointed tools, which will enable him to promptly take care of all inquiries. The company also maintains an office at 501 Hobart Building, San Francisco.

INDUSTRIAL NOTES

The directors of the Brown Hoisting Machinery Co. have announced the death of their chairman, Harvey H. Brown, on Aug. 2.

Graham Bright, general engineer in charge of the coal and metal mining department of the Westinghouse Electric & Manufacturing Co., has joined the firm of Howard N. Eavenson & Associates, mining engineers, Union Trust Building, Pittsburgh, Pa. Mr. Bright will give special attention to power house systems, power plant appraisals, transportation and transmission systems for coal and metal mines, and general power applications.

Stafford X. Comben, of 32 West 40th St., New York, has resumed private practice for making of examinations and reports on proposals for public works and general construction contracts in the domestic and foreign fields.

To meet the demand for haulage work in metal mines where requirements demand the use of an exceedingly small locomotive on account of cage dimensions and where haulage is done on more than one level, the General Electric Co. has developed a 1½-ton locomotive fitted with a pantograph collector. Its general flexibility makes it particularly applicable where side clearances are limited and curves short.

The locomotive weighs 3,000 lb. and is built for 18 or 20-in. gage. The over-all length is 48-in.; height, 42 in.; width, 34 in. It is equipped with one 110-volt series motor giving a speed of 5 miles per hour.

The board of directors of the Atlas Powder Co., at a meeting held Aug. 15, declared a dividend of $1 per share on the no-par-value common capital stock, payable in cash, Sept. 10, 1923, to stockholders of record at the close of business on Aug. 31, 1923.